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DEPARTMENT OF THE ARMY

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THE PETROLEUM HANDLING EQUIPMENT RESEARCH AND DEVELOPMENT PROGRAM OF THE DEPARTMENT OF THE ARMY

ANNUAL REPORT

DECEMBER **1960**

QUARTERMASTER RESEARCH & ENGINEERING COMMAND

NATICK, MASSACHUSETTS

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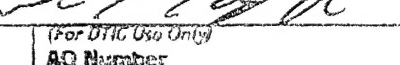

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DEPARTMENT OF THE ARMY
PROGRAM ON
RESEARCH and DEVELOPMENT
OF
PETROLEUM HANDLING EQUIPMENT

FIFTH ANNUAL REPORT

OFFICE OF THE QUARTERMASTER GENERAL
DEPARTMENT OF THE ARMY
DECEMBER 1960

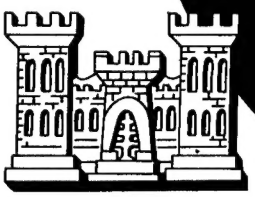
ORDNANCE CORPS

Develops Special Purpose Bulk Fuel Haulers and Wheeled and Cargo Vehicles for POL Transport

TRANSPORTATION CORPS

Develops Rolling Fluid Transporters and Marine and Rail equipment for movement of POL products

THE DEPARTMENT OF THE ARMY PETROLEUM HANDLING EQUIPMENT RESEARCH AND DEVELOPMENT PROGRAM



CORPS OF ENGINEERS

Develops equipment for Marine Terminals, Bulk Storage Facilities, and Pipeline Systems

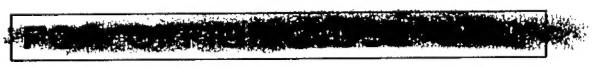
SIGNAL CORPS

Provides communication support for operating POL Supply Systems

QUARTERMASTER CORPS

In addition to planning and coordinating the Army POL Program, assures implementation of military concepts, and develops: Portable Class III Storage Transfer and Dispensing Equipment, Collapsible Containers, Bulk Fuel Conversion Outfits for General Purpose Cargo and Personnel Transporters, and Quality Control Laboratory Test Equipment

PHE RESPONSIBILITIES OF THE DEPARTMENT OF THE ARMY



FOREWORD

This report was prepared by the U. S. Army Quartermaster Corps under the authority and responsibilities contained in Department of the Army Research and Development Directive No. 11, 4 March 1960, copy appended. These responsibilities were originally assigned in Department of the Army Research and Development Directive No. 23, 16 December 1955.

Significant accomplishments made during the period 1 January - 31 December 1960 in the Department of the Army Petroleum Handling Equipment Research and Development Program are contained in this Annual Report.

The assistance of the Corps of Engineers, Ordnance Corps, and Transportation Corps, is gratefully acknowledged.

TABLE OF CONTENTS

Bulk Petroleum Handling Systems have been developed to support strategic and tactical requirements of Field Commanders

SUMMARY

The primary objectives of the Army petroleum handling equipment research and development activities conducted during this report period have been continuously to improve the Army's capabilities for supplying and distributing petrol (fuel), oils and lubricants (POL) at any time, in any tactical situation, and in any area of the globe. Development tasks have been pursued in efforts to achieve maximum benefits inherent in flexible, mobile and economic distribution systems. Emphasis has been placed on improved equipment and systems for advancing bulk fuel concepts (including transport of large quantities of petroleum products as far forward as possible in combat zones, with maximum delivery direct from bulk fuel carriers to using vehicles) and on improved capabilities for ship-to-shore transfer of bulk petroleum products.

In the very critical area of Marine Terminal Equipment studies were made to establish the parameters associated with anchoring tank ships under variable wind, wave and current conditions. A prototype 50,000-lb. holding power explosive emplaced anchor assembly was tested and design principles were established for the full size 300,000-lb. item.

The use of flexible submarine pipelines at the seaward terminus appears practicable based on the development of new operations technique. Informal agreement, at DOD level, has provided for Army developing seaward terminus systems of 8-inch and larger, while the Navy would be responsible for smaller systems.

The 12-inch Booster Service Pumping Station completed engineering tests with only minor deficiencies (now corrected) and plans call for an extended operational test supporting port operations at Donges, France, in lieu of a service test.

A 50,000-foot long Flexible Hoseline System (Assault Support) including 4 new pumping units, accessories, and hoseline repair equipment was shipped to the Seventh Army for use in an operational exercise.

The development of the Flaking Box, POL Hoseline, Storage and Stringing has been completed and Standardization action is in progress. Development of Hoseline Valves, Fittings, Displacement and Evacuation Kit, Repair Kit, Gap-Crossing and Road-Crossing Equipment has been completed and prototypes were furnished to the Seventh Army for use in an exercise.

In cooperation with the Office of the Director, Defense Research and Engineering, Air Force, Navy and Aeronautical Standards Group, a draft of a new specification covering filter/separator testing procedures was prepared.

The POL Pipeline Operational Dispatch Center was shipped to the Petroleum School, Fort Lee, Virginia for use in training. The Meter, Flow Indicating and Recording, Orifice Type, for Pipeline Service has completed service testing.

Development has been completed on the QMC 500-gallon collapsible fuel container for use in storage, air transport (fixed and rotary wing) and aerial delivery applications and action is currently underway to standardize the container for such applications. Since this container is completely sealed (without vents) the mere metering of the fuel being transferred into the container is not a satisfactory filling procedure due to the varying amounts of air which may have been previously inadvertently introduced in the container. Prototypes of a reliable automatic shut-off fueling device have successfully undergone engineering tests. This device precludes over-pressurization of the 500-gallon container during fueling operations.

The container, collapsible, 5,000-gallon (formerly identified as 6,000-gallon capacity) satisfactorily completed transportability tests on railroad gondolas and box cars under a joint QMC-TC test program and user test results promise early type classification action.

The concept of a rectilinear military bulk fuel container having an outer shell of rigid structural members and an internal bladder to prevent leakage of fuel is receiving much enthusiasm and interest from industrial as well as military elements since initial contractor "bread-board" model has performed in line with all expectations.

Development of the 5- and 8-gallon expendable containers for water and fuel respectively, culminated in submission of prototypes for test by Marine Corps as these items were designed to meet Marine Corps requirements.

Both cleaning equipment and rear as well as forward area repair equipment for collapsible containers have successfully completed engineering tests and only minor modifications will be necessary.

The lightweight COT (coordinated oil testing) Knock Testing Engine satisfactorily completed service test of both Motor and Research Methods and type classification action has been initiated. Modification kits will be necessary for testing by Supercharge, Aviation and Cetane Methods and additional efforts are being directed towards expediting the development of these conversion components.

Development was completed on the Low Temperature Combination Laboratory Unit which combines the following elements in one unit:

a. Low Temperature Kinematic Viscosimeter.
b. Cloud and Pour Point Apparatus.
c. Channel Point Apparatus.

Service tests are underway.

The Fuel Blending Kit, which provides a fireproof item for use in Petroleum Laboratories and the POL Gauging Kit, which provides equipment for measuring and gauging petroleum products in field storage tanks, tank cars and other bulk fuel facilities, completed service tests in a satisfactory manner and type classification actions have been initiated.

During the year, the standardization program on quick-disconnect couplings for use by all ABC countries and eventually all NATO countries was completed. The draft ABC standard is being circulated.

The 1,000-gallon T3 Transporter, Liquid, Rolling Wheel Type was placed in limited production during the past year and was distributed to the Seventh US Army, CONARC, USARAL, TREOG, UK, Canada and others for user evaluation. In order to provide greater wear life, a program is underway to develop a 500-gallon fuel cell wheel from polyurethane compounds. This wheel will fit the T3 as well as the T6 (an improved version of the T3) Transporters, Liquid, Rolling Wheel Type.

The Association of American Railroads has completed testing of the side frames and bolsters of the rail tank car universal gauge and has given the Transportation Corps approval to operate this tank car with multi-gauge feature in domestic interchange service.

Three (3) prototypes of the Truck, Tank, Fuel Servicing, High Mobility, 5,000-gallon, 4x4, XM438 (GOER) have completed tests at the Armor Board, Arctic Test Board, Yuma Test Activity and also evaluation by the Quartermaster Corps. Test results were satisfactory with recommendations that development of the XM438E1 vehicle be accomplished expeditiously. Four (4) prototypes of the new model incorporating fuel tank and ancillary equipment of military design with other improvements are scheduled for delivery to test agencies early in 1961. This XM438E1 vehicle will be equipped with a filter/separator located within the fuel cargo tank of the vehicle, although accessible from the top for servicing.

The Semi-Trailer, Tank, Fuel Servicing, 5,000-Gallon M131E3 is an all-aluminum version of the M131 series designed to supersede the original M131 Refueler which was excessively heavy. Two (2) other versions of this item have been developed: The M131E5 incorporates a closed pressurized system for fast refueling and automatic bottom loading; the M131E6 incorporates a filter/separator, meter and other delivery equipment including three (3) 15-foot lengths of suction hose. It is expected that the latter item will replace the M131E3.

To expedite refueling of military vehicles, a new closed pressure system designed for fast refueling is being evaluated by the Ordnance Corps. The new system provides refueling at the rate of approximately 100 gallons per minute without dangerous loss of vapors in the vicinity of the nozzle. Plans call for further evaluation of this system by the Quartermaster Corps during 1961.

Research, engineering, and development efforts will continue in accordance with the revised Petroleum Handling Equipment Research and Development Program, to assure that POL Handling Systems are responsive to the Army's needs, thereby enhancing the military capability of the United States and its allies to participate successfully in large-scale thermonuclear warfare and/or smaller-scale military actions.

CHAPTER I

DEPARTMENT OF THE ARMY RESEARCH AND DEVELOPMENT

FIVE-YEAR PROGRAM ON

PETROLEUM HANDLING EQUIPMENT

The revised Department of the Army Research and Development Program (FY 1960-1964) on Petroleum Handling Equipment, prepared in 1959 by the Quartermaster Corps in coordination with the Corps of Engineers, Ordnance Corps, and Transportation Corps, was published 1 January 1960. The revised program incorporates new concepts and material which have become available for the future Army in the Field, and is directed toward improving distribution and supply methods to insure constant availability of fuel and petroleum products needed to power the engines of war and peace.

The purpose of this revised Program is to:

ESTABLISH Army-wide guidance and objectives for the development of Petroleum Handling Equipment and related construction and maintenance equipment;

ELIMINATE duplications and projects of little or marginal value;

EMPHASIZE essential elements of the program and expedite an early state of readiness; and

MAKE MAXIMUM UTILIZATION of research and development funds.

This Five-Year Program establishes:

* DEVELOPMENT TASKS which are essential to meet the petroleum handling equipment needs of the Army

* PRIORITY DESIGNATION of each task

* DEVELOPMENT SCHEDULE for each task

* RECOMMENDED FUNDING LEVEL for the FY 1962 period

The primary objective of this Program is to improve petroleum supply and distribution capabilities of the Army on an expeditious and continuing basis. It also assures that efforts and funds are not expended on tasks which will delay the operational availability of critically needed items.

To furnish maximum guidance, the following priority designations were established:

Priority 1 - Those tasks which include <u>critically</u> needed items required to correct a deficiency in current capabilities. Every effort should be made to shorten the development time of these tasks, even at the expense of delaying lower priority tasks.

Priority 2 - Those tasks which include <u>essential</u> items to improve petroleum supply and distribution capabilities of the Army.

Priority 3 - Those tasks which include <u>desirable</u> items to improve petroleum supply and distribution capability of the Army.

Priority 4 - Those tasks which include items in a <u>suspended</u> status.

CHAPTER II

SIGNIFICANT ACCOMPLISHMENTS OF THE TECHNICAL SERVICES

Within the framework of the Department of the Army Petroleum Handling Equipment Research and Development Program, participating Technical Services have made notable progress in developing new and improved petroleum handling equipment and systems, including construction equipment and techniques for pipelines and appurtenances and for storing, protecting, transporting, and dispensing the tremendous quantities of fuels, oils and lubricants needed at any time, in any tactical situation, in any area of the world.

In planning and developing POL handling equipment and systems, Army POL technologists and engineers have taken into consideration such pertinent factors as:

EFFECT of technological developments on the POL resupply requirements for a particular type of fuel for organizational elements of the Army in the field. For example, jet fuel requirements for Army prop-jet aircraft are in addition to regular aviation gasoline requirements.

SUPPORT to the United States Air Force, Navy, and Marines as well as allies. For example, Army POL equipment and systems support Army and Air Force units currently assigned to the Seventh Army in Europe.

INTEGRATION of major equipment and systems for most effective employment. For example, pipelines, delivery by aircraft including air-landed and air drop, tank trucks, barges, railroad tank cars and general transporters for bulk and packaged POL.

In spite of significant advances being made, there is still a need for new POL supply systems and equipment to support adequately the new modern mobile army. Some of the problems are highlighted in the QM Board Report (classified SECRET) on Petroleum Supply for the Army in the Field, dated May 1960 as well as in Operations Research Office Report on The US Army in 1965-75 - Problems of Supply Logistics, dated July 1960.

PART 1

CORPS OF ENGINEERS

The U. S. Army Corps of Engineers, through its Research and Development Laboratories (USAERDL), Fort Belvoir, Virginia, conducts research, engineering, design and development activities directed toward the provision of facilities necessary to and in support of transportation of liquid fuels by pipeline. Major types of facilities include marine terminals, on- and off-shore bulk storage installations, pipelines and hoselines for overland transportation. Equipment and techniques to permit the timely and effective construction and maintenance of all fixed POL facilities are being designed and developed.

1. MARINE TERMINAL EQUIPMENT

Marine terminal facilities must not only be highly flexible in meeting a wide range of hydrographic, climatic and operational conditions but they must also be so designed that they can be installed quickly by troop units utilizing, insofar as possible, standard items of floating plant and construction equipment. Since dispersion and duplication of marine terminal POL facilities will be required, equipment must be designed for rapid and effective installation. In compliance with D/A guidance major emphasis is being placed on those development tasks that will insure a ready capability for moving bulk POL supplies ashore in the early phase of military operation under open sea conditions, including:

a. Mooring, Tanker, Off-Shore, Variable Depth. Concurrent with work being carried out on the development of a quickly emplaced high holding capacity anchor device, an extensive study and investigation was made to establish the nature and extent of the forces acting on various sizes of tank ships under variable wind, wave and current conditions. Close coordination has been achieved with some elements of the oil industry that operate tanker fleets for the purpose of establishing data applicable to the design of rapidly emplaced, effective, off-shore tank ship moorings. An explosive emplaced anchor assembly with 50,000-lb holding power was designed and developed during 1960. Testing was conducted at Port Hueneme, California, with support being furnished by the Naval Civil Engineering Laboratory and the Pacific Missile Range. From results of this work, design parameters for the full size 300,000-lb capacity anchor were established. Planned fabrication of 300,000-lb anchors for testing in the latter part of FY 61 may be deferred due to a lack of funds. Data established in the course of the mooring forces study have been made available to the Office of Civil & Defense Mobilization in support of a classified project. Figure 1 illustrates an early design assembly of the experimental 50,000-lb explosive emplaced anchor being readied for loading on the test vessel at Port Hueneme, California. Figure 2 illustrates an improved 50,000-lb test vehicle mounted in the instrumented firing fixture prior to being embedded.

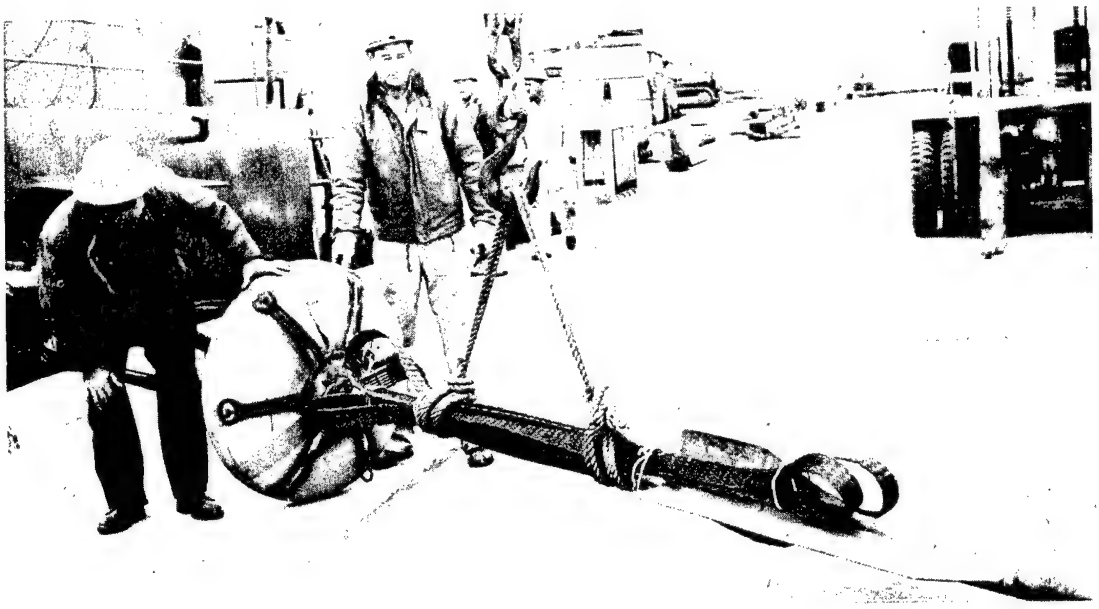


Figure 1. 50K experimental explosive emplaced anchor assembly of early design readied for loading on Navy vessel for test firing.

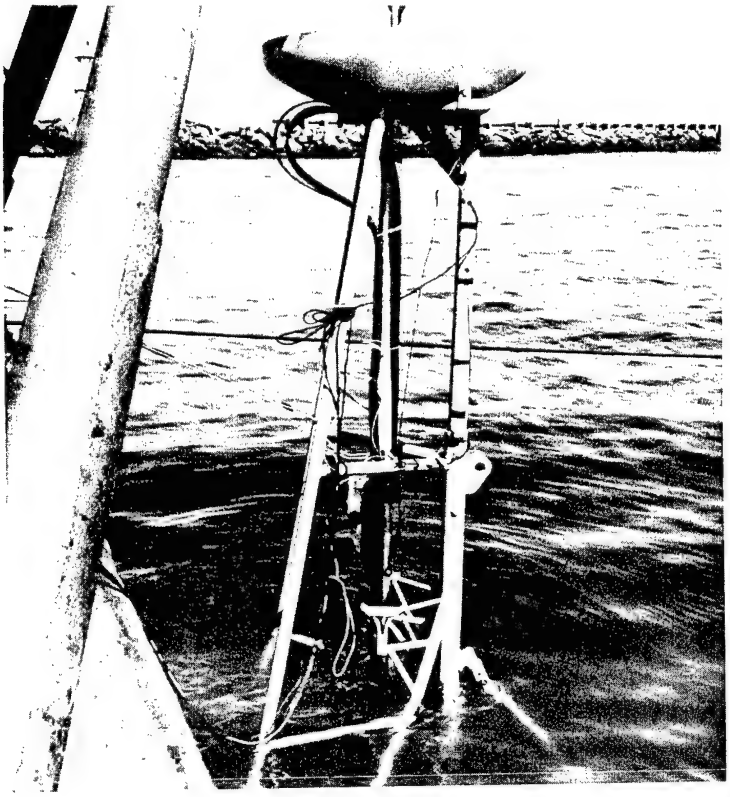


Figure 2. Refined 50K explosive emplaced anchor assembly in test fixture ready for lowering and emplacement at USNCEL, Port Hueneme, California.

Design work and model tests have also been conducted at Fort Belvoir, Virginia on a positive buoyancy hawser system, weighing about 25-lbs per foot which has the same shock absorbing characteristics and strength as an anchor chain weighing 623-lbs per foot. In addition to effecting a great weight reduction in this item of equipment, its use will also reduce the size of the mooring buoy which contains the embedded anchor and mooring hawser system. Preliminary designs of a mooring point incorporating the anchor, hawser, shock absorber and buoy have been prepared.

b. Tank, Submersible, Rigid, POL Storage, 50,000-Barrel Capacity. An interim engineering report covering work accomplished through 1959 on the development of the 50,000 barrel submersible tank was completed. Further work on this project has been suspended in accordance with a Department of the Army directive.

c. Terminal Operating Center, Submersible. Work on this facility has been suspended in accordance with a Department of the Army directive.

d. Pipeline, Submersible, Welded, 6-, 8-, 12- and 16-Inch. Redesign of the components of the submarine pipeline systems was necessary to permit utilization in exposed sea areas and to eliminate features which created major construction and operational difficulties. Development of a new operational technique permits the utilization of a lightweight collapsible type hose on the seaward terminus. Complete 8- and 16-inch assemblies have been procured for use in carrying out the engineering tests of the construction equipment scheduled for accomplishment in FY 62. Finalization of the numerous components of these systems will be accomplished following successful installation tests. Further work on a 6-inch system has been terminated by agreement, at DOD level, that the Army would concentrate on 8-inch and larger systems and the Navy would be responsible for all smaller systems.

e. Hose, Submarine, POL, High Pressure, Ship-to-Shore, 8-Inch. The primary concept of the application of a submarine hoseline is based on the requirement that a bulk POL resupply capability by D+4 is imperative. The submarine type hoseline must be capable of rapid emplacement using simple, readily available, tactical type floating equipment. It must be protected against the free movement of all tactical surface craft. Fabrication of an experimental long length submarine hose, in 6-inch size, was completed but one of the 250-foot lengths failed due to inadequate adhesion between the plies. Scheduled surf testing will be resumed with a new design in which the required negative buoyancy is accomplished by incorporating a spirally wound lead cable. An experimental length has been procured for tests. Preliminary designs for the shipping and placement reels have been prepared and scale models fabricated to fully establish detail requirements. Design and fabrication of a weighted hose with a high degree of flexibility constitute major developmental problems.

f. Hose, Floating, High Pressure, POL, Ship-to-Shore, 8-Inch. A 500-foot length of experimental 8-inch floating hose was delivered but failed during the course of preliminary engineering tests. Repairs are being accomplished by the fabricator. Scheduled surf tests of this hose have been deferred. A short section of a new type very lightweight hose has been procured for engineering test and evaluation. Preliminary designs have been prepared for shipping and handling equipment but final design will be held in abeyance pending establishment of the physical characteristics of the hose to be utilized.

g. Marine Dock, Tanker Unloading Systems, 4 through 16-Inch. Designs for the basic facilities are contained in Technical Manual 5-302, "Construction in the Theater of Operations." Design of a gallows-type hose handling system to support use of these facilities has been completed but further work has been held in abeyance.

h. Terminal, Prefabricated, Spud Barge Type. Work has been suspended in accordance with a Department of the Army directive.

i. Pumping Station, Off-Shore, Floating, 12-Inch. Work has been held in abeyance pending completion of higher priority development tasks.

j. Pumping Station, Booster Service, 12-Inch. The 12-inch booster station is designed to provide a throughput capacity range of 3000 BPH at a 2400-foot head to 6000 BPH at 1720-foot head using two 12-inch pumps in series, or 6000 BPH at 1200-foot head to 12,000 BPH at 860-foot head using two 12-inch pumps in parallel, when off-loading T-2 or larger tankers. Engineering tests on the prototype unit have been completed at USAERDL and Yuma, Arizona; a formal engineering report has been prepared and will be published early in 1961. Plans have been initiated to ship the unit and its manifold assembly to Europe for an extended operational test in support of port operation at Donges, France. Since facilities to conduct a service test are non-existent and would be extremely expensive to construct, the report recommends waiver of any service testing. An extended operational test, under military control, will establish long term maintenance requirements and overall suitability for the application.

Figure 3 shows the unit in engineering test.

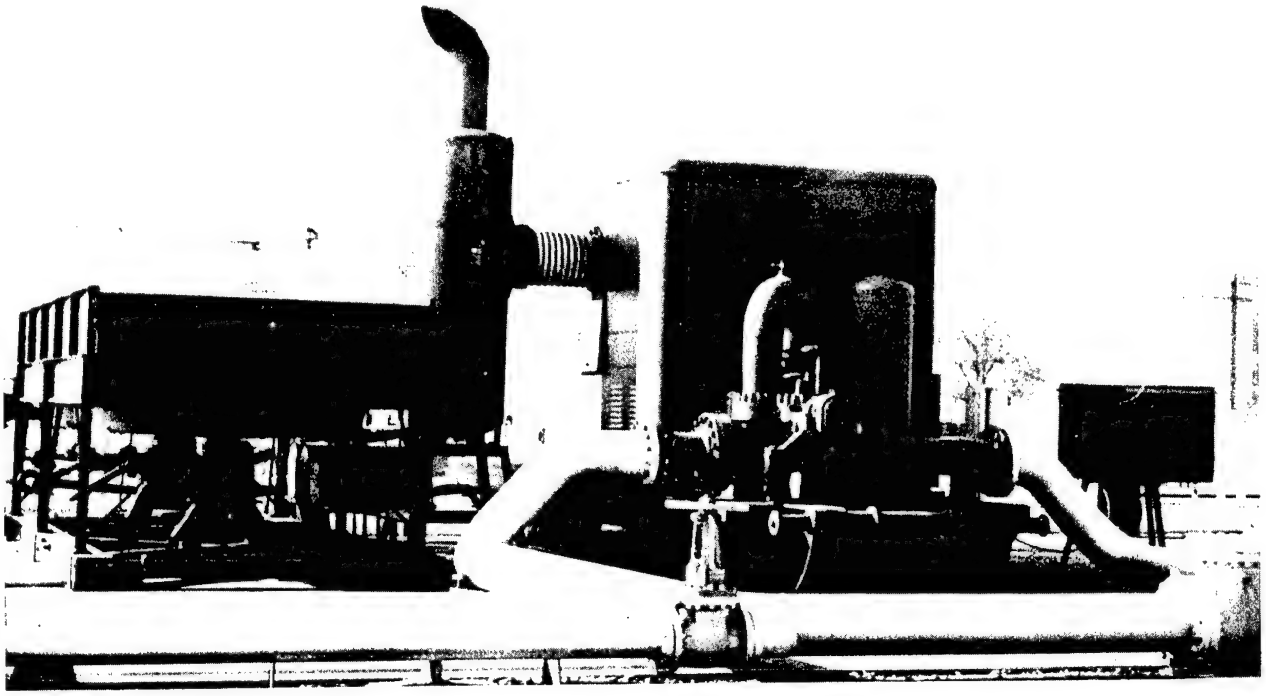


Figure 3. 12-inch high pressure, diesel engine driven pump. Used at 12-inch pipeline booster stations, this unit can pump 3000 gpm at a head of 1100-feet.

k. Container, Storage, Collapsible (Floating) 50,000-Gallon Capacity. Further work on this item was held in abeyance in conformance with Staff directive. Of necessity, the experimental fuel cells were utilized in support of other POL development projects. An interim engineering report has been prepared and will be published in 1961.

l. Terminal Facilities for Collapsible Floating Storage. Work on this facility was held in abeyance in compliance with Staff directive.

2. MARINE POL TERMINAL CONSTRUCTION EQUIPMENT SETS

Development in this area has been directed toward new techniques which will utilize standard military floating plant and construction equipment supplemented, as required, by special items necessary to support rapid and effective construction. In the category of submarine pipeline construction, design and planning has been directed toward completely installing one 5000-ft long hose line from 8- through 16-inches in diameter in 3 days following the arrival of troops and material at the site, and paralleling such line with one additional line per subsequent day. Army engineers, by working closely with commercial pipeline contractors, have developed a technique of launching and placing a submarine pipeline.

a. Submarine Pipeline Construction Equipment Set. The feasibility study leading to the selection of a primary method for constructing and installing submarine pipelines off-shore into the open sea was completed in 1959. All essential equipment and supplies have been selected; procurement and/or fabrication of the equipment required is in progress. Following an extensive analysis of hydrographic and other conditions at all Government-owned coastal installations tentatively selected for the tests, a survey party made an extensive under-water study of the sea bottom off the NE coast of the island of Vieques. It was decided to conduct the engineering tests in 1961 off Fisher's Island, N. Y. Permission has been obtained from the Navy to utilize the real estate required to assemble the pipelines prior to launching. Drawings and specifications were prepared to cover the many specialized items of equipment required. Actual outfitting of the floating plant being borrowed from the Transportation Corps is scheduled to begin in March 1961.

b. Barge, Off-Shore Pipeline Construction. This project was suspended pending development of the automatic pipeline welding machine.

c. Equipment, Off-Shore Hose Laying. Preliminary designs of a large reel-like hose layer will be completed after the physical characteristics of the hose are fully established.

d. Equipment Set, Off-Shore, Tanker Mooring. This project has been suspended pending the detail determination of requirements, following establishment of the final design of the mooring system components.

3. ON-SHORE BULK POL STORAGE FACILITIES

One of the primary problem areas in implementing the bulk POL logistics concept involves provision of effective receiving, regulating and holding storage facilities. Practical design limitations preclude the development of the bolted type storage tanks in capacities greater than 10,000-bbls. Even this type tank weighs 42-tons and requires considerable effort to erect. The need for a larger capacity tank, especially in port areas, led to the design of a 50,000-bbl welded steel tank weighing over 12-tons. Although the welded tank does provide essential unit capacity, the lack of experienced welders will continue to limit its probable utilization. Since any conventional above-ground cylindrical tank constitutes a relatively "soft" target to the effects of ground, air or missile attack another "harder" type storage medium is essential. The self supporting collapsible fuel tank provides one type that can be installed quickly; however, its ultimate capacity is limited. New materials again make it feasible to consider the liner type tank as a storage reservoir. If current objectives areattained, it is probable that rigid above-ground bulk storage tanks of the conventional type will become obsolete for military field use.

a. Reservoir, Bulk Fuel Storage, Hasty. Engineering tests were initiated in May on the experimental 10,000-bbl size hasty storage reservoir. Several methods devised to facilitate the collection of rain water have been tested and evaluated with varying results. Hurricane Donna's storms dumped almost 3-inches of rain on the reservoir, illustrated in Figure 4. A tear in one corner of the coated fabric cover resulted.

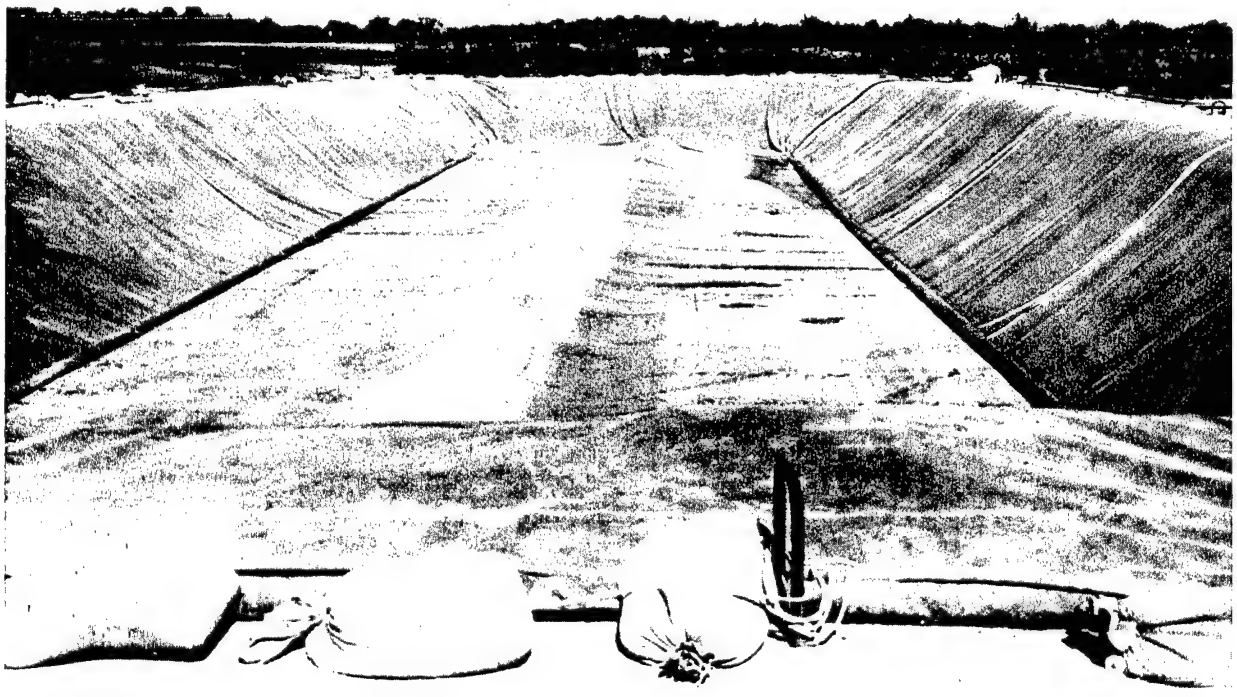


Figure 4. 10,000-barrel fuel storage reservoir. The reservoir contained 4500-bbls of fuel when the photograph was made.

Work with a scale model is continuing with results being applied to the development of a 10,000-bbl experimental reservoir. An alternate design has been prepared and a 4000-bbl capacity tank has been fabricated for test using a coated fabric weighing only 15-oz per square yard. This tank is of the envelope type and will require use of a berm-like support. Both tanks are fabricated from a modified polyester coated nylon cloth with cemented seams. Permeability is less than 30-gallons per acre per day and the material is unaffected by low temperature. Laboratory tests indicate no adverse effect on any standard military hydrocarbon fuels stored in the tanks.

b. Manifold Facilities for Hasty Storage Reservoir, 6-, 8- and 12-Inch. Design and development of manifold facilities essential to the effective utilization of the reservoir type bulk POL storage tank are being carried out concurrently with work on the basic tanks.

c. Tank, Steel, Welded, Cone and Floating Roof. Task completed.

d. Valves and Fittings. All work suspended for lack of funds.

e. Manifold Facilities, Surface, Coupled, 6-, 8- and 12-Inch. No work was done in 1960.

f. Tank, Bolted, Aluminum, Knock-down, 100-, 250-, 500- and 1000-Barrel Capacity. Task completed.

g. Kit, Gauge, Liquid Level, Indicating, for Bolted Storage Tanks. The final report covering design of this simple effective kit was published and distributed.

h. Pump, Straight Centrifugal, 6-Inch. Task terminated.

i. Pump, Centrifugal, 8-Inch for Transfer and Flood Pumping Service. No work was accomplished for lack of funds and technical effort.

j. Equipment Set, Tank Inspection and Cleaning. Although not funded, preparation of the final report was completed. Considerable work remains to be accomplished in finalizing essential procurement data.

k. Tool Set, Construction, Welded Steel Tanks. Task completed.

l. Machine, Automatic, Tank Welding. No work was done in 1960.

m. Underground Storage. No progress. Work suspended due to lack of funds.

n. Tank, Steel, Prefabricated, Quickly Erected, 30,000-bbl. No progress. Work held in abeyance due to lack of funds.

4. FLEXIBLE HOSELINE SYSTEM (ASSAULT SUPPORT).

Work leading to the design and development of all basic components essential to a fully operational flexible 4-inch hoseline system has been completed with the exception of necessary service testing of the new pumping units and their control devices. A 50,000-foot long system including 4 new pumping units, accessories, and hoseline repair equipment was shipped to the 7th Army for use in an operational exercise. This system, with a design capacity of 320-bbls per hour, is intended for use in beach head and air head areas as a means for transporting relatively small volumes of fuel in bulk, over limited distances, for a short period of time. One complete 2½-mile system was procured for use in conducting an extensive system demonstration and operational service test and to verify the procurement data prepared on all components of the system.

a. Hose, Lightweight, Collapsible, 4-Inch. In 1959, a 2000-foot length of hose was procured from each of three companies in an attempt to establish a broad procurement base; two of the three 2000-foot experimental lengths have met specification requirements and have been delivered for final testing and evaluation. However, the limitations of existing production methods and techniques preclude the fabrication of a collapsible hose having the low weight and cubage sought. Since little or no commercial application for the end item exists, development costs must primarily be borne by the Government; work with industry to encourage the development of an improved hose that could be economically mass-produced will continue.

b. Pump, Portable, for Hoseline. Eight prototype pumping units were delivered this year for engineering and service testing. The units were designed to deliver 225 gpm at a 350-foot head and were equipped with hydraulically operated controls and safety switches to protect the hoseline. Using these pumps, a nominal pump station spacing of 2.5 miles is possible on level terrain. Engineering tests at USAERDL and the QM Test Station, Yuma, Arizona have been completed. Four units were shipped to Europe for use in a 7th Army military exercise. The engineering report has been prepared and will be published early in 1961. Figure 5 illustrates the complete pumping unit as developed for 4-inch hoseline service. Two units are scheduled for Service Testing in 1961 after the engineering report has been published.

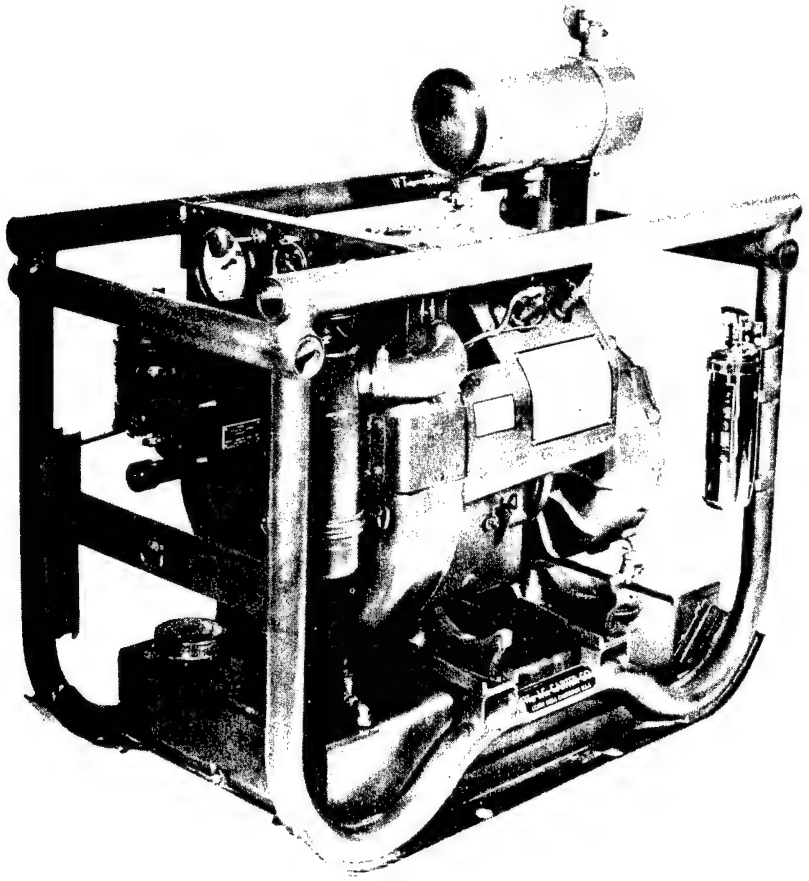


Figure 5. 4-inch gasoline driven pumping unit. Used in the 4-inch lightweight collapsible POL hoseline system, this unit can pump 225 gpm at a head of 350-feet. The hydraulically operated control is just below the discharge pressure gage and is used to maintain line flow rates and pressures with present limits.

c. Flaking Box, POL Hoseline, Storage and Stringing. Development has been completed, the final report published, and standardization action is being processed.

d. Valves and Fittings, Hoseline. Design and development have been completed and the final report prepared. Prototype units were furnished to 7th Army for use in conducting an exercise.

e. Equipment, Tools, and Techniques for Installation, Operation, Maintenance and Recovery of Hoselines. Work on the design and development of the displacement and evacuation kit, repair kit, gap crossing and road crossing equipment has been completed and an engineering report prepared. Prototype kits and components were furnished 7th Army. Results of that operation may reveal requirements for design changes or additional components.

5. LIGHTWEIGHT, COUPLED, SURFACE LAID PIPELINE SYSTEMS (TACTICAL SUPPORT).

The surface-laid, coupled-type pipeline systems are the primary means for the transportation of bulk POL. Work leading to the design and development of the numerous components essential to fully operational 6- and 8-inch trunk pipeline systems is continuing on a "funds availability" basis.

a. Tubing, Pipeline, Grooved, Coupled, Aluminum. Task completed.

b. Bends, Long Radius, Preformed, 4-, 6-, 8- and 12-Inch. Although no funding was allocated to this task, an interim engineering report covering prior work has been prepared. Additional work is necessary and should be accomplished as soon as funding permits.

c. Pumping Station, Trunk Pipeline, 6-Inch. All engineering tests, including desert environmental tests, have been completed and a formal report prepared. Since facilities for effectively service testing the units do not exist, preliminary plans have been made to release the compression-ignition and electric motor driven pumping units and the station manifold assembly to the 7th Army for an extended operational test. Units are scheduled for installation in the 10-inch NATO line (St. Baussant-Zweibrucken).

d. Pumping Station, Trunk Pipeline, 8-Inch. Engineering tests, including desert environmental, have been completed on the newly developed 8-inch high-pressure, compression-ignition engine driven, packaged pumping unit. Detailed designs were prepared for a coupled manifold assembly but lack of funds necessitated deferring the procurement scheduled in FY 60. Both the electric motor and engine driven versions of the packaged pumping unit are planned for installation in European pipeline systems under military operational control. Preparation of the formal engineering report is scheduled for the 4Q61. Service testing is not feasible since facilities do not exist and would be very costly to provide.

e. Stripping System for Multiple Unit Trunk Pipeline Station. No progress. Work suspended due to lack of funds.

f. Pressure Regulating Stations, 6- and 8-Inch. Previous work on the design and development of pressure regulating equipment capable of the required range of application has not been successful. A formal engineering report has been prepared and published. Additional work must be done to provide this essential element of any pipeline system. No work, other than completion of the report, was accomplished in 1960 because of lack of funds.

g. Control, Hydraulic, Regulating, for 6-Inch 2-Stage and 4-Inch 4-Stage Pipeline Pumps. Although work on this equipment was suspended due to lack of funds, preparation of the engineering report was completed so the equipment could be service tested at an early date. The resultant control is essential to the effective utilization of the direct drive pipeline pumping units in the supply system.

h. Pumping Station, Trunk Pipeline, 12-Inch, Lightweight, Turbine Driven. Work leading to the design and development of this turbine powered unit has been suspended.

6. HIGH PRESSURE WELDED PIPELINE SYSTEM (LOGISTIC SUPPORT).

Work on all components of the high pressure, welded type pipeline system has been held in abeyance pending resolution by Staff of the feasibility of utilizing such a system in a theater of operations. No funds have been allocated or work programmed.

7. PIPELINE CONSTRUCTION AND MAINTENANCE EQUIPMENT.

Wider application of the bulk concept for supplying liquid fuels to all elements of a military operation, and the constantly increasing requirements for this class of supply by both ground and air elements will necessitate utilization of a major portion of the engineer troop's effort for constructing and maintaining military pipeline systems. Since the coupled type pipelines and hoseline systems have no commercial counterparts, it is necessary to develop equipment and techniques for their construction which will provide maximum sustained installation rates with the minimum of troop effort. The added necessity for duplication of critical installations to provide continued support under modern concepts of warfare further increases the magnitude of the construction requirement.

a. Machine, Welding, Automatic, Pipeline, 8-Inch. Active work on the experimental, solid-phase, pipe girth welder was terminated on 4 January 1960 as a result of Corps of Engineers decision that coupled pipelines will be employed for overland petroleum distribution and where welded lines are required, such as submarine pipelines, manual welding will be employed. At that time only a few experimental welds had been made and only partial adjustment accomplished. The

weld made at that time proved to be of excellent quality. Figure 6 illustrates the results of some of the physical tests made on that weld. Two responsible commercial firms have formally expressed a desire to take over work on the field type solid-phase welder. Several minor design changes are planned before any extensive testing is undertaken. An interim engineering report is being prepared.

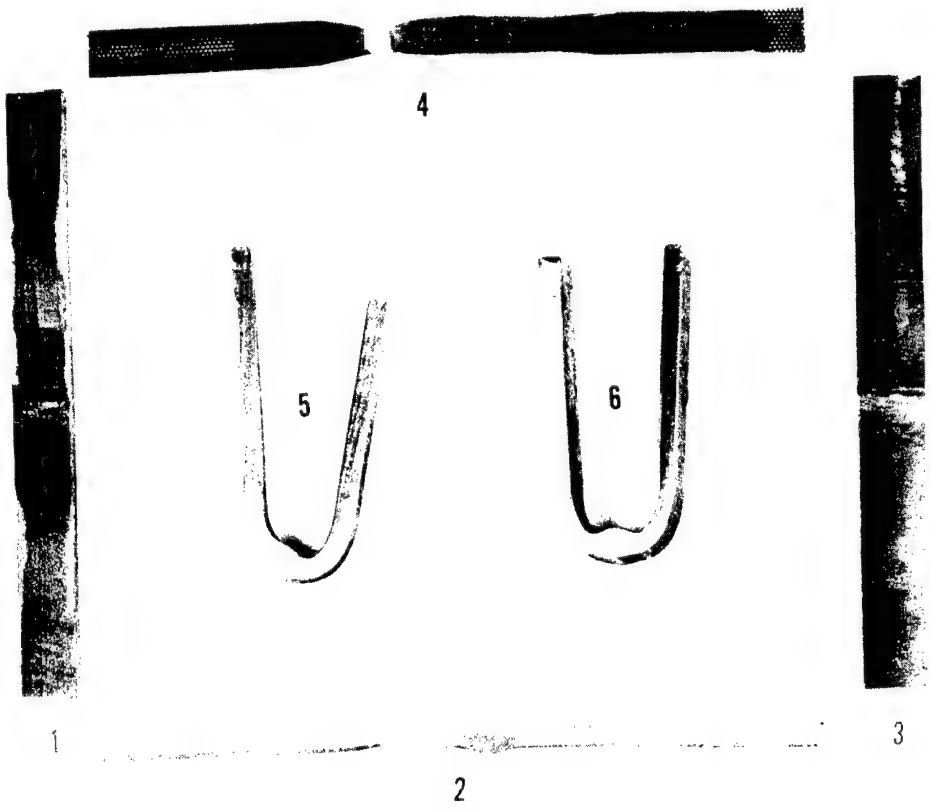


Figure 6. Physical test specimens of 8-5/8-inch OD Grade B seamless steel pipe having 5/16-inch wall joined employing the experimental solid phase girth welder. 1 and 3 are sections showing inside and outside of pipe through weld zone; 2 and 4 are tensile test specimens which failed at 68,600 psi stress, and 5 and 6 are bend test specimens.

b. Machine, Welding, Automatic, Pipeline, 12-Inch. No work programmed. Terminated.

c. Pipe Transporter, 6-Ton Capacity. Redesign, modification and successful testing of the stringing boom power train was accomplished to overcome minor deficiencies and the applicable procurement drawings and specifications modified.

d. Pipe Transporter, Heavy Duty. Task suspended.

e. Pipelayer, Crawler Mounted, 75,000-lb Capacity. An interim report was prepared to support type classification of this item. The formal engineering report has been prepared and will be published early in 1961. Since the bending shoes are an accessory to the pipelayer, they were included in the same report.

f. Bending Shoes, Pipe, for use with Pipelayer. Work on testing and evaluation of this commercially available item has been completed and is being covered in the report of the pipelayer.

g. Tool Sets, Welded Pipeline Construction. Task completed.

h. Machine, Pipe Cutting, for Hazardous Locations. Task completed.

i. Machine, Boring, Pipeline Road Crossings. All work on the road boring machine has been completed except preparation of the final engineering report which will be published early in 1961.

j. Ditcher, High Speed. Item deleted from program.

k. Sling Set, Pipe and Tubing, Handling and Stringing. Task completed.

l. Survey Equipment Set, Corrosion Protection. No action. Work held in abeyance for lack of funds.

m. Radiographic Weld Inspection Equipment. No action. Work held in abeyance due to lack of funds. Commercial equipment and operating personnel will be contracted for to provide this vital service in support of the off-shore pipeline construction equipment tests.

n. Cleaning and Coating Equipment and Material. No action. Work held in abeyance for lack of funds and will not be reprogrammed unless the welded type pipeline is accepted for military field use.

o. Pipeline Construction Equipment and Techniques. Funding and efforts allocated for construction equipment were directed toward eliminating the design deficiencies encountered with the stringing boom of the pipe transporter. Additional work was done on preparing procurement data for components of the pipeline construction equipment tool sets.

8. PIPELINE QUALITY CONTROL EQUIPMENT

Work in this category in 1960 was concentrated on providing equipment capable of meeting requirements for fuel cleanliness. In cooperation with the Office of the Director, Defense Research and Engineering, Air Force, Navy and Aeronautical Standards Group, a draft of a new specification covering filter/separator testing procedures was prepared. A large volume of work on filter/separators was done for the Air Force and Navy on a prefunded basis. Construction of the filter/separator research laboratory was initiated in September with completion scheduled for February 1961.

a. Research on Removal of Solids and Water from Petroleum Fuels. This project involves the determination of the composition and physical properties of fuel contaminants, and the phenomena of fine particle filtration and water coalescing. Investigations have been made of the effects of the addition of corrosion inhibitors to fuel, altered fuel characteristics (particularly interfacial tension), and permissible specification variations. Studies of coalescence, drop formation and behavior, and other water and solids removal phenomena were conducted using a micro-coalescer and high speed photography.

b. Filter/Separator, Portable, Field Type, 20 GPM. Unfavorable reports were received from two of the agencies accomplishing the service tests of this 2-stage unit developed, on a crash basis, for primary use by Army Aviation units. An evaluation of the procedures utilized in evaluation of these units indicates that they were subjected to unrealistic operating conditions. All remaining prototype units were released to the Navy to fulfill an urgent requirement in support of operation DEEPFREEZE. Redesign of the unit to use the standard single stage canister and element utilized in all other filter/separator units, was initiated.

c. Filter/Separator, Mobile and Portable, 50 GPM. Engineering tests and evaluation of the prototype unit was completed. Numerous design changes were made as a result of these tests. A contract was awarded for 6 units to be delivered in December 1960. These will be subjected to extensive engineering tests at USAERDL before being released for further test and evaluation by the several using services. Application is to the 1200-gallon refueler and QM rear-mounted conversion kit plus as a portable unit in dispensing operations. One unit of the portable type will be released to the Marine Corps for evaluation.

d. Filter/Separator, Mobile and Portable, 300 GPM. Prototype models were delivered and engineering tests were initiated.

Preliminary test results indicate satisfactory performance. Several minor design modifications were made to simplify effective element sealing and to provide improved field operational features. Eight steel units are being procured for further engineering tests at USAERDL and for evaluation by other services.

e. Filter/Separator, Fixed and Portable, 600 GPM. Design drawings were modified to reflect modifications found necessary based on results of tests of prototype 300 GPM size unit. Three steel units are under contract for extensive engineering tests. Delivery is scheduled in December 1960.

f. Operational Dispatch Center, POL Pipeline. The final report was prepared and published. Prototype assembly fabricated at USAERDL was shipped to The Petroleum School, Fort Lee, Virginia, for use in training.

g. Meter, Flow Indicating and Recording, Orifice Type, for Pipeline Service. Service testing has been completed and one report received. Unit is generally acceptable. Case design has been modified to improve weather protection and the shipping pack has been changed.

h. Cleaners, Brush Type, Fluid Propelled, 4-, 6-, 8-, 10-12-Inch. No work scheduled or funded. Designs currently standard must be reviewed when work on the long radius bends is resumed.

i. Detector, Batch Interface, for POL Pipeline. Although no work was programmed or funded an interim engineering report covering work previously accomplished was prepared and published. Further work on the radioisotope absorption type interface detector was not recommended. Work is scheduled to be resumed in FY 63.

j. Batch Segregation Equipment and Techniques, Products Pipeline. Project held in abeyance for lack of funding and technical effort.

k. Detector, POL Contaminants, Stream Monitoring Type. Project held in abeyance for lack of funds.

9. CLASS III SUPPLY POINT ASSEMBLAGE

a. Pump and Filter/Separator, Trailer Mounted (see Part 2, Section 3b). Design and development of the unit was completed and one unit delivered to the Quartermaster Research and Engineering Command for further evaluation. Figure 7 illustrates the unit mounted on the standard 1½-ton Ordnance cargo trailer.

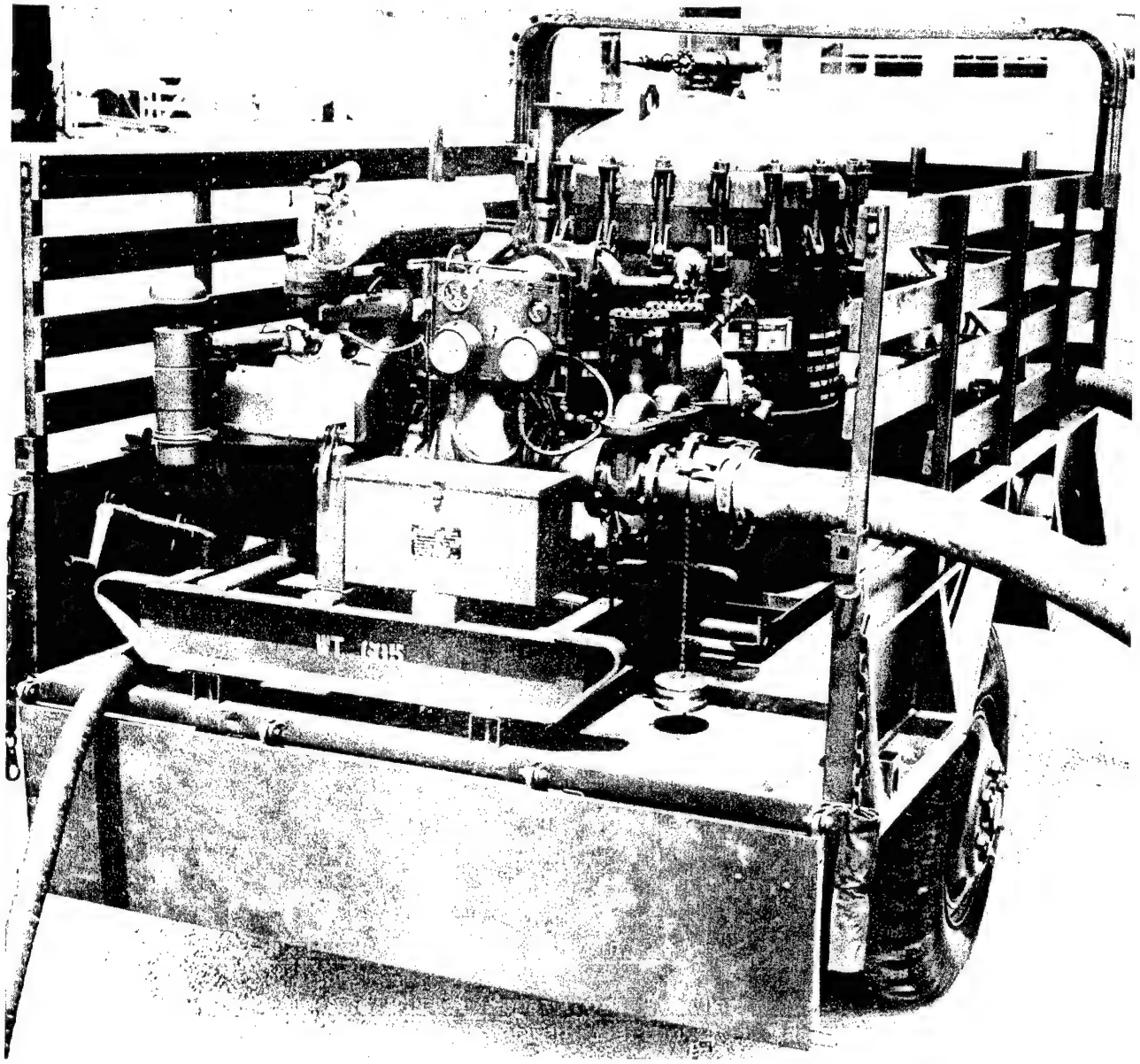


Figure 7. Trailer-mounted pump and filter/separator. Units of this design are intended to be used for transfer and receiving service in Class III Supply Points.

PART 2

QUARTERMASTER CORPS

In carrying out its Department of Army POL responsibilities, the Quartermaster Corps performs a dual role. In addition to planning and coordinating the Army Petroleum Handling Equipment Program to assure that the components and handling systems are responsive to military needs, the Quartermaster Corps, through its Research and Engineering Command, Natick, Massachusetts, develops new and improved equipment and systems for distributing, dispensing, containing and testing petroleum products. Significant accomplishments made during the past year include:

1. PETROLEUM CONTAINERS, COLLAPSIBLE. The collapsible container program, which was given highest priority again this year, progressed very satisfactorily. Development of collapsible containers of 500- and 5000- gallon (formerly 6000) capacities was completed and emphasis was placed upon fabricating laboratory evaluation prototypes of the military model bulk fuel container utilizing the more promising of two initial designs.

a. 500-Gallon Collapsible Containers. Development of the 500-gallon bulk liquid fuel container for use in storage, air transport (fixed and rotary wing) and air delivery applications was completed this year. Action is being taken to type classify the container for these applications (see Figures 8 and 9). Service tests of the containers in surface transport applications and as a component of conversion outfits are scheduled for completion in 1961 and 1962. The container is approximately 46-inches in diameter and 80-inches long; it weighs about 270-lbs and when collapsed may be folded into a package approximately 15% of its filled size. Tests on a limited number of containers indicate a bursting pressure of approximately 55 psi. The container is equipped with swivel connections and shackles to permit handling, towing and tie-down; the end plates are connected internally by cables to restrict longitudinal expansion when the container is pressurized or suspended. The container is equipped with a valve and quick-coupling adapter for filling and emptying.

Type classification of the container as a component of conversion outfits for tracked and wheeled vehicles is planned in 1962.

Figure 8. The 500-gallon collapsible container will be used for delivery of fuel by fixed-wing aircraft.

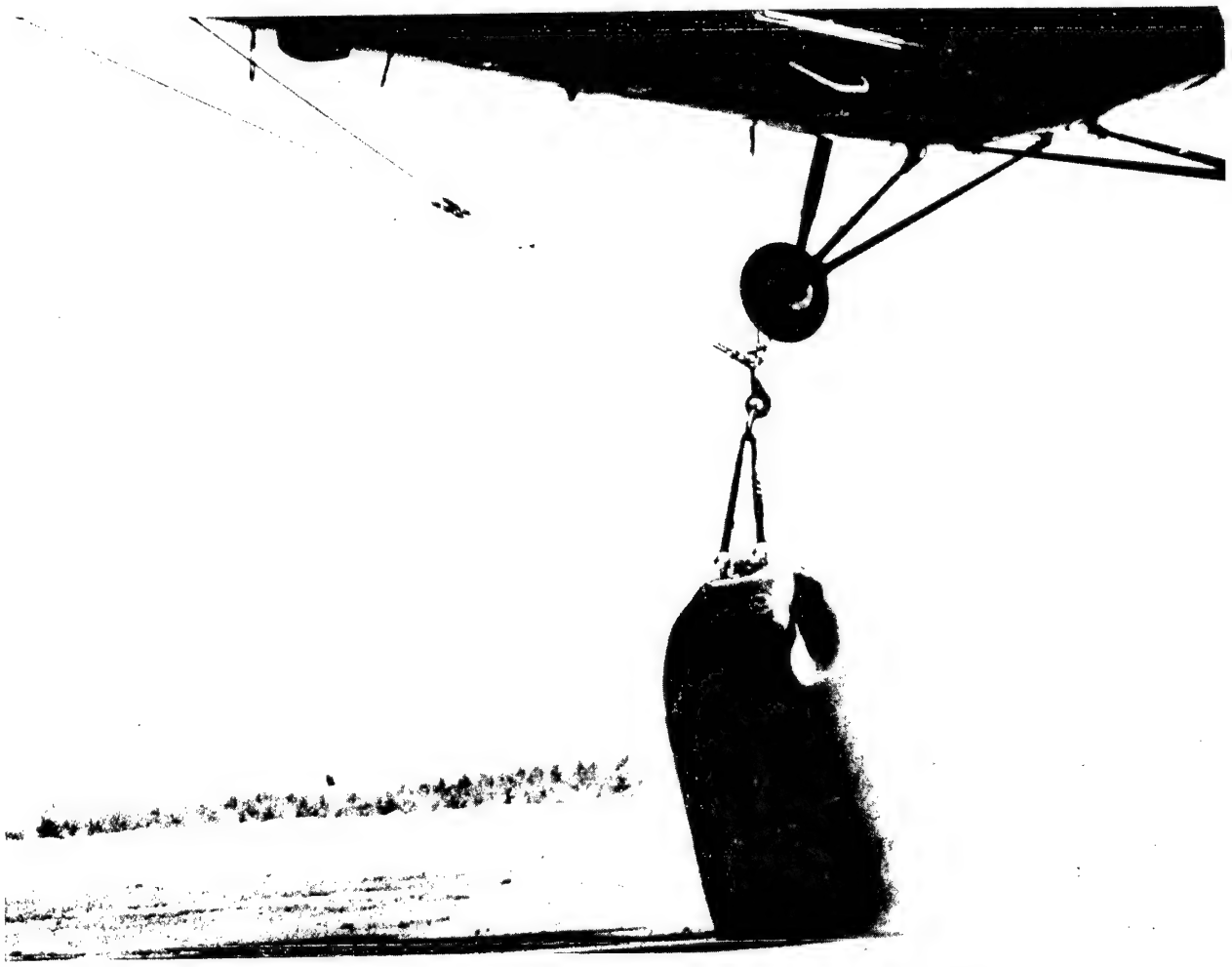
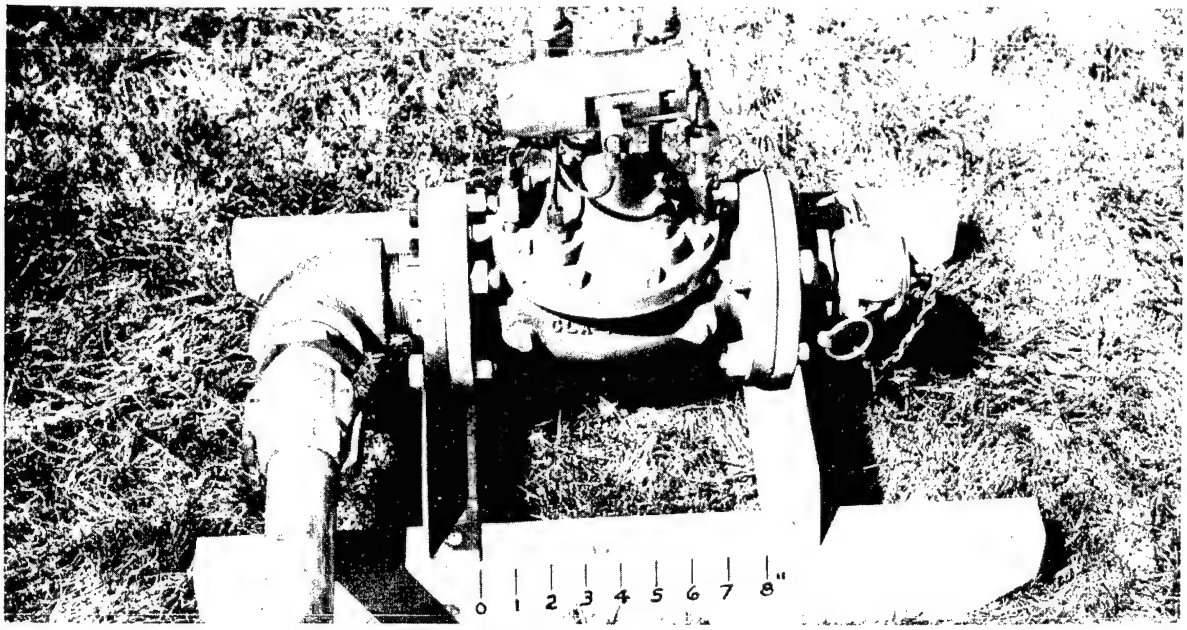
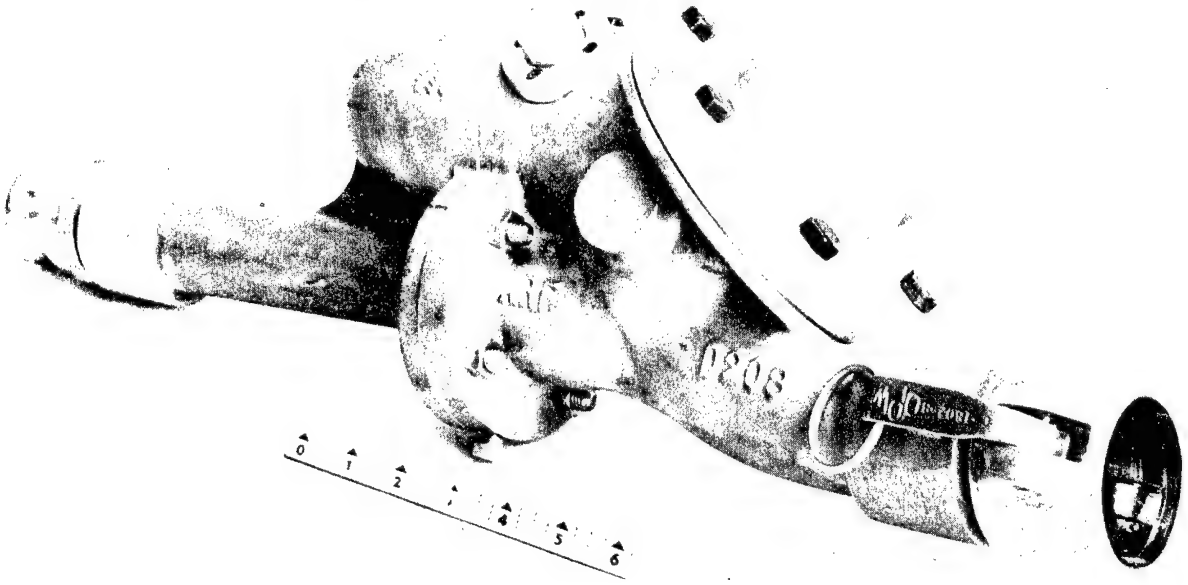


Figure 9. In helicopter delivery of fuel in the 500-gallon collapsible container, no platforms, nets or special rigging are necessary.

Since the collapsible container is completely sealed and has no vents, merely metering the fuel into the container does not indicate the resultant internal pressure in the container due to the varying amounts of air which may have previously been introduced into the container. Initial prototypes of a reliable automatic shut-off fueling device successfully underwent engineering tests this year. Tests of modified devices (see Figure 10) which incorporate the identical principle with more rugged and compact construction essential for field use are planned next year.



Initial Prototype



Modified Prototype

Figure 10. This device prevents bursting of 500-gallon collapsible containers by stopping the flow of fuel into the container when the internal pressure reaches 5 psi.

b. Container, Collapsible, 1000-Gallon Range. - Task terminated. This size container is not compatible with the new Ordnance vehicles.

c. Container, Collapsible, 5000-Gallon. This large POL container (formerly indicated as having 6000-gallon capacity range) is designed to provide a lightweight, portable, bulk container for converting railroad gondolas and other rail transport equipment (which is not designed for transporting liquid cargo) into bulk fuel haulers. This container is also to be used in marine landing craft for transporting bulk quantities of fuel from ship to shore. In addition, it will provide a good portable static ground POL storage facility. Transportability tests of this 5000-gallon collapsible container on railroad gondolas and box cars were successfully completed this year under a joint Quartermaster Corps - Transportation Corps test program and informal service test results promise early type classification of the item for these applications (see also 2f and 2g, Cleaning and Repair Equipment).

d. Military Bulk Fuel Container. - Further evaluation of this container resulted in increased emphasis being placed upon completing detailed design drawings for the rectilinear configuration. This container, which has a capacity of 350 gallons and is approximately 56" x 40" x 46", consists of an aluminum outer shell and an inner fuel-resistant bladder. The shell and liner are so designed that they can be collapsed into a predictable, uniform configuration. The inner liner is attached to one side of the outer shell. When the bladder is empty this side may be folded in over the liner and the base of the container. The opposite side folds down next. The section consisting of the top and the ends which are hinged at the bottom, top and in the middle, folds down on top of the other sections (see Figure 11). Collapsed dimensions are approximately 56" x 40" x 10". The weight of the empty container is approximately 220-lbs. The base of the container is designed to accommodate handling of filled or empty containers by forklift trucks. When collapsed the flat top surface has floor loading capacities sufficient to permit loading and transport of dry cargo items up to the normal truck capacity without removing the containers. Prototypes are expected early in 1961. Extensive laboratory evaluation is planned prior to engineering and service tests. This concept is receiving much enthusiasm and interest from industrial as well as military elements since initial contractor "bread-board" model has performed in line with all expectations.

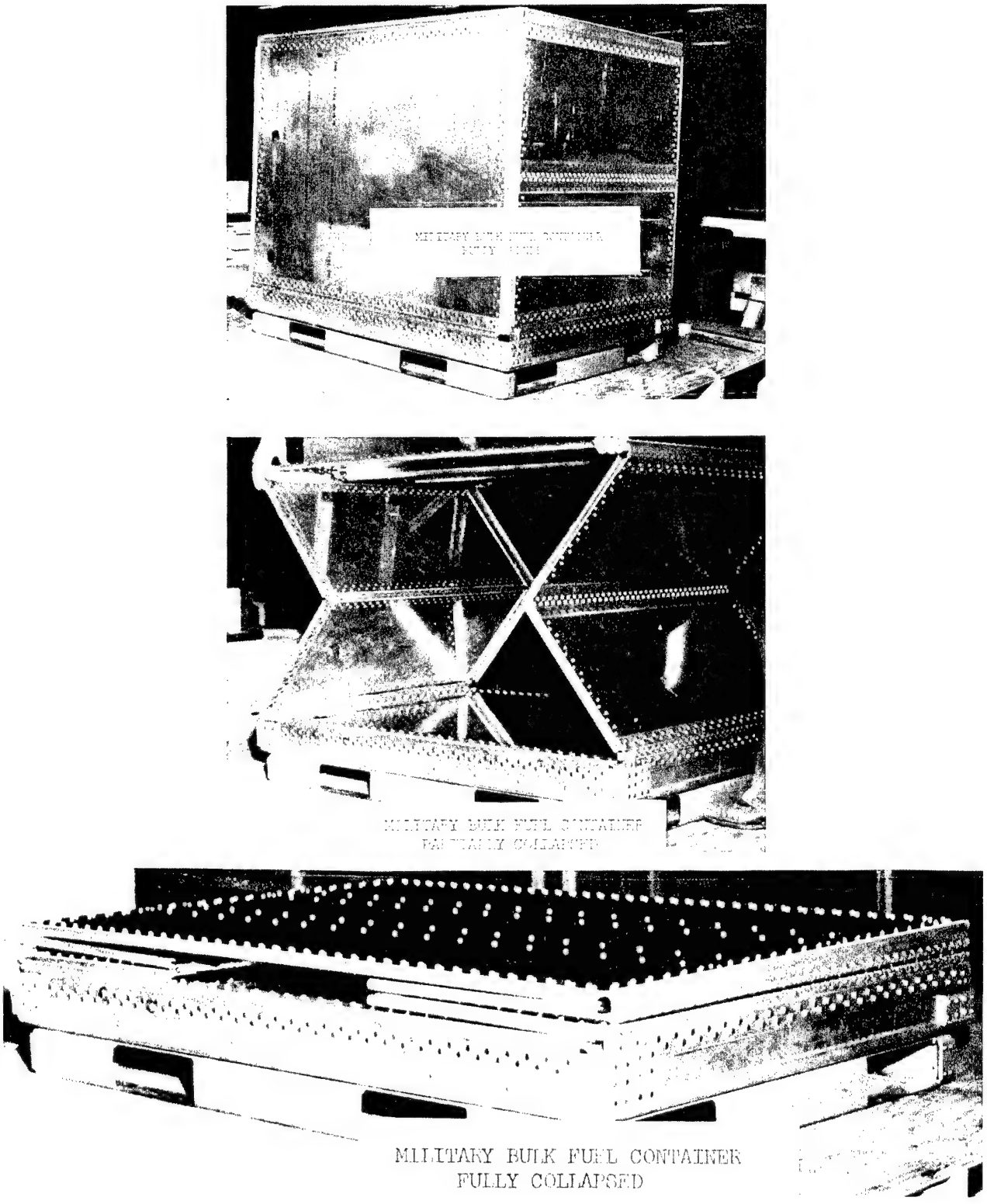


Figure 11. The military bulk fuel container will permit conversion of all general-purpose cargo transport media into expedient POL carriers.

e. Containers, Expendable, 5- and 8-Gallon. Development was completed this year on the expendable 5- and 8-gallon water and fuel containers which were designed to meet a Marine Corps requirement. These containers are made up of waterproof fibreboard "knock-down" outer containers designed with handles, and plastic inner liners (see Figure 12). These items will provide an expendable method for distributing POL supplies in packaged form. They will permit maximum utilization of transport media by providing a package of minimum weight with ease of handling. The containers were shipped to the Marine Corps Equipment Board, Quantico, Virginia early this year for extensive field tests. A final report is expected by January 1961. Outside of Marine Corps testing, this project is at a standstill since Army Staff has not supported this program.

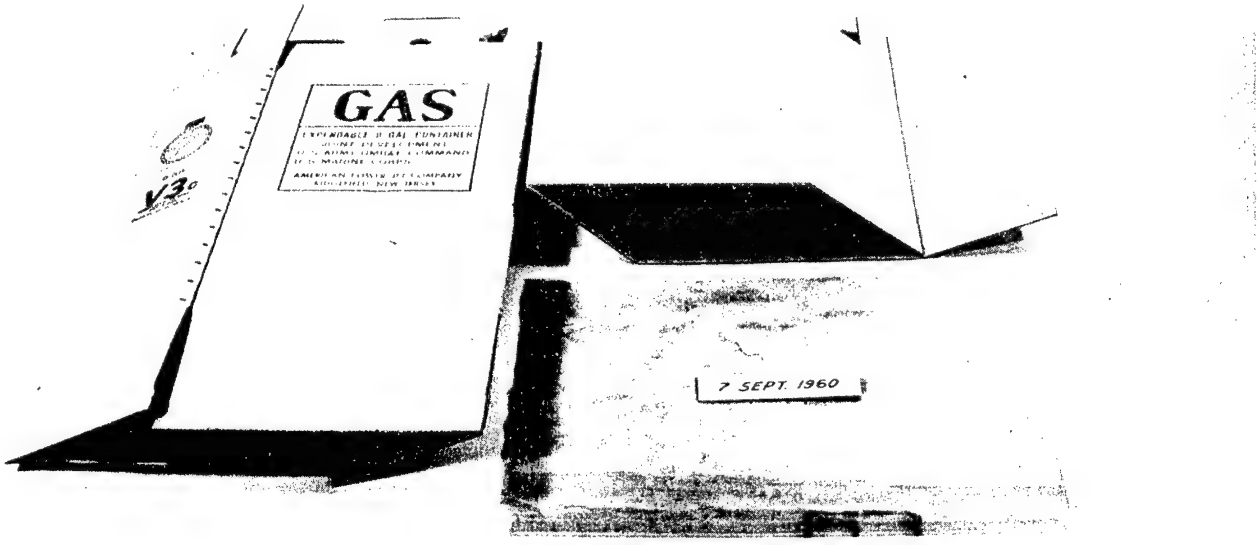


Figure 12. This expendable container will provide a method of distributing POL supplies in packaged form and permit maximum utilization of transport media.

f. Cleaning Equipment for Collapsible Tanks. With the introduction of potentially vast quantities of collapsible containers into the supply system, effective cleaning equipment is necessary to minimize contamination of fuels, maximize safety of handling by eliminating unnecessary volatile fuel vapors, and provide for maximum performance of present and future engines for use in ground and air equipment. This cleaning equipment will be portable for use in the field as well as in depot operations, and is designed to loosen and remove sludge and trapped fuel vapors from within the containers. Engineering tests of the first prototype have been completed this year. An improved second prototype (modified to provide equipment to spray a fine petroleum preservative mist on the inside of collapsible containers to replace oils which have been partially removed through cleaning and purging processes) is expected to undergo service tests in 1961.

g. Repair Kits. Collapsible containers of the cylindrical and pillow types which are now under development are expected to be damaged in field use. Suitable field methods of repair are needed so that the tanks can be used with a minimum loss of POL products and container replacements. Two repair kits have been developed; each repair kit is applicable to the repair of both the 2-ply pillow type and the 4-ply cylindrical type fuel tanks. One kit is designed for forward area (1st and 2nd echelon) emergency repair (see Figure 13) and the other kit is designed for rear area (3rd echelon), permanent repair. The forward area repair kit is intended for temporary repair to be conducted immediately upon detection of punctures and tears without emptying the tanks. The kit will permit these repairs to be made at extremely low temperatures. The kit contains two sizes of cylindrical rubber plugs for closing punctures and three sizes of threaded conical rubber plugs for closing tears up to about 2-inches in length. The cylindrical and conical plugs are made of Buna-N rubber. The kit also contains metal sealing clamps in three sizes for tears up to 7-inches long. The rear area repair kit is designed for permanent repairs on empty tanks. This kit consists of a portable vulcanizing unit, a supply of adhesive and patches in three sizes.

Tears up to one foot in length may be permanently repaired. The kit can be used where 110 volt AC power is available. Engineering tests of both kits have been initiated.

1. Metal Case 16" x 7" x 8"
2. 1/4 Cylindrical Plug - 10 ea.
3. 1/2 Cylindrical Plug - 10 ea.
4. Inserting Tool for 2 & 3
5. Small screw patch for punctures - 10 ea.
6. Large screw patch for tears up to $1\frac{1}{2}$" - 10 ea.
7. Inserting tool for 5 & 6
8. Rotary cutter - 4 ea.
9. "Yankee" tool for cutter
10. Small conical screw plug - 5 ea.
11. Medium conical screw plug - 5 ea.
12. Large conical screw plug - 5 ea.
13. 7 Inch metal sealing clamp - 3 ea.
14. 5 inch metal sealing clamp - 3 ea.
15. 3 inch metal sealing clamp - 3 ea.
16. Pliers for 10, 11 & 12
17. Lubricating cement
18 Repair instruction Manual

Figure 13. This forward area (1st and 2nd echelon) repair kit will permit emergency repair of collapsible containers without emptying the tanks.

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2. BULK POL CONVERSION OUTFITS. To implement military concepts which place emphasis on the flexible delivery of fuel from bulk carriers to using vehicles, efforts have been directed toward developing a family of conversion outfits which convert standard military vehicles into bulk fuel carriers and dispensers. Progress in developing these conversion outfits includes:

a. Conversion Outfit, Cargo Vehicles, Rigid Containers. Task completed.

b. Conversion Outfit, Cargo Vehicles, Collapsible Container. This outfit consists of a dispensing kit equivalent to the standard kit with a gasoline engine drive. The rigid tanks are replaced by two or three 500-gallon collapsible containers, the number depending on the size of the cargo vehicle (see Figure 14). Although developed primarily for 5-ton 6x6 general-purpose trucks, it can be efficiently adapted to trucks and trailers of smaller capacities by decreasing the number of containers. The gasoline pump engine assembly will be interchangeable with the experimental electric drive pump engine assembly under development. The outfit will provide a means for collapsing the tankage to permit use of cargo vehicles for movement of personnel, supplies, ammunition, equipment or fuel without removal of tanks from converted vehicles. Test prototypes are nearing completion. Engineering tests will be initiated early next year.

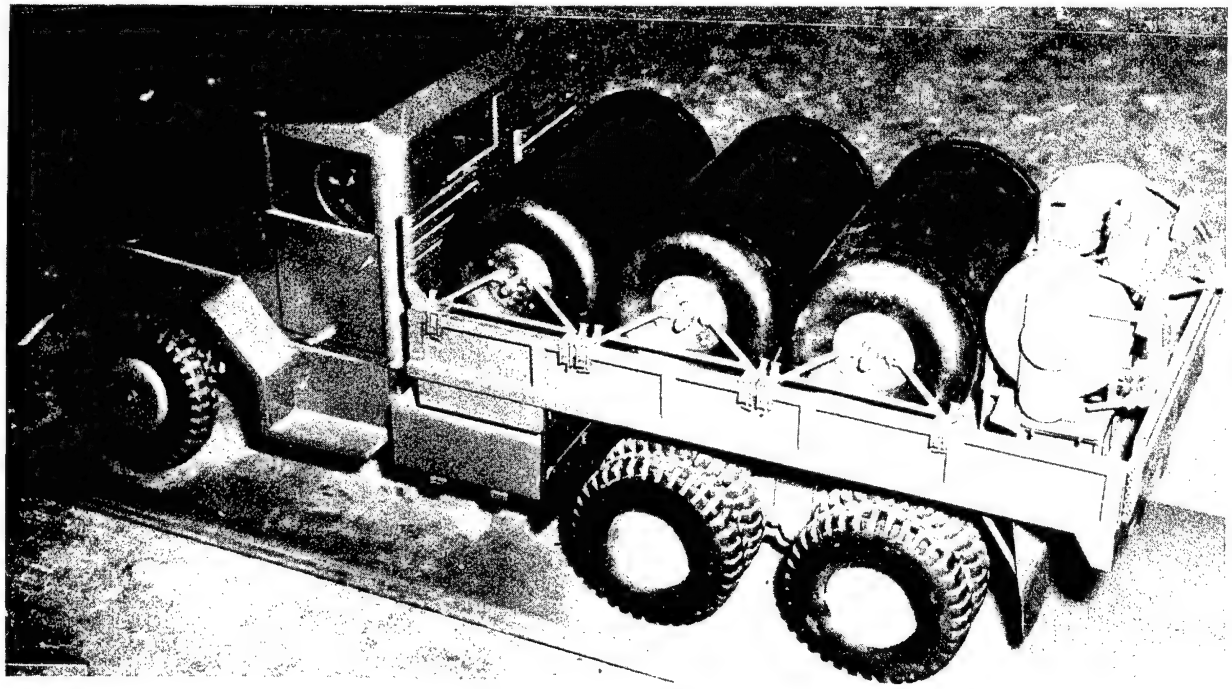
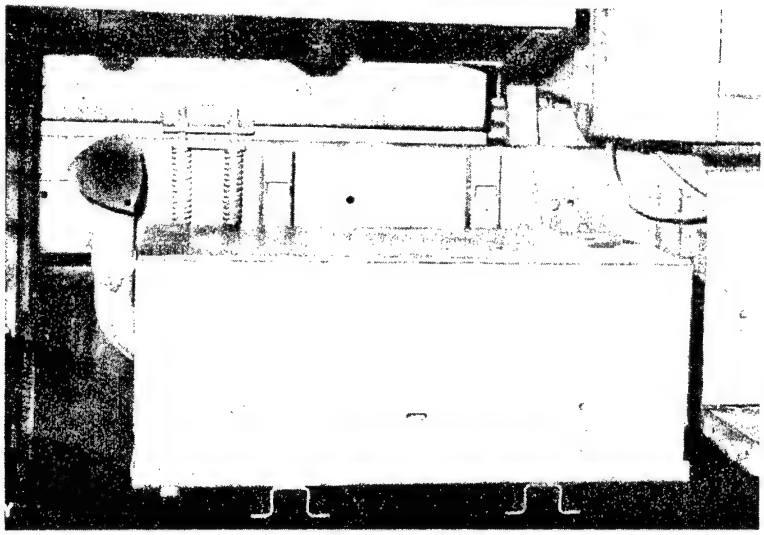


Figure 14. This outfit will adapt general-purpose cargo vehicles to bulk fuel dispensers, making it possible for these vehicles to be used interchangeably for movement of personnel, supplies, ammunition, equipment or fuel.

c. Conversion Outfit, Cargo Vehicles w/Electric Power Source and Collapsible Containers. Development of an improved outfit for conversion of all wheeled cargo vehicles into bulk fuel haulers continued this year. Using results of the study of an optimum power source (which indicated that the electric drive system had the greatest promise), development of a compact lightweight unit was undertaken. The first prototypes, containing filter/water separator, hose reels, compact meter and special high speed electric motor drive centrifugal pump were completed this year (see Figure 15). The pump will be powered by the vehicular electrical system (28V, 100 amp alternator) developed for use with all new general-purpose cargo vehicles. Laboratory testing is expected to be completed in early 1961.

d. Conversion Outfit, APC M-59, and New Series Armored Multi-Purpose Vehicle, w/Collapsible Containers. (Conversion Outfit for all Tracked Vehicles w/Filter/Separator.) This outfit will consist of an electric-drive kit and collapsible containers. The kit will contain a filter/separator, a 28 volt DC submerged pump, an explosion-proof motor, 100' of hose and 2 nozzles. Dimensions have not been finalized; two approaches to the electric drive kit were completed this year under separate contracts. A model incorporating the best features from these approaches is scheduled to start engineering tests in 1961. The complete outfit, which will utilize military bulk fuel containers, will provide a maximum bulk fuel-carrying capacity for the new tracked personnel and cargo vehicles and will insure high quality of fuel delivered through the employment of a filter/separator component. It will also provide the capability of fueling two vehicles simultaneously.

As an interim measure, to provide an expedient means of converting the M-59 and M-113 personnel carriers into bulk fuel haulers, an outfit has been developed utilizing a 500-gallon collapsible container. The outfit is currently undergoing Arctic tests. Type classification is scheduled in 1962.

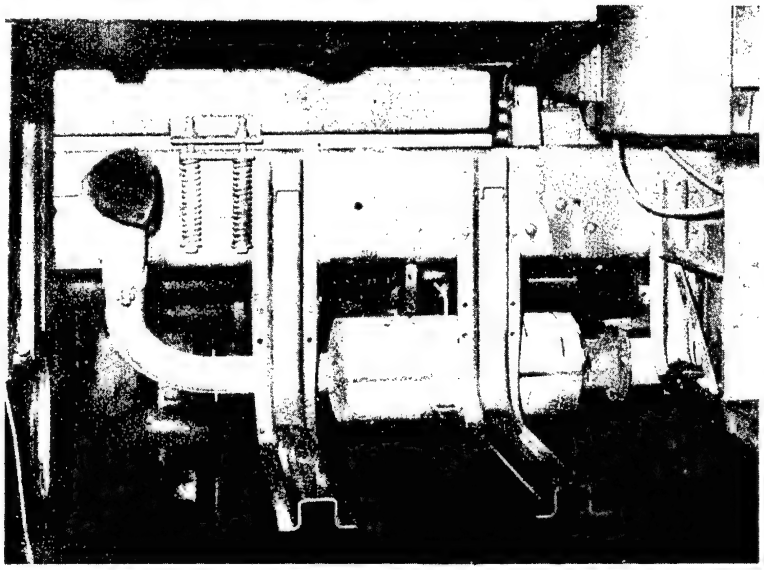


1

(1) Tool and storage box in place on right-hand side of vehicle.

(2) Tool and storage box removed from brackets.

(3) Tank and pump unit, liquid dispensing, mounted on vehicle.



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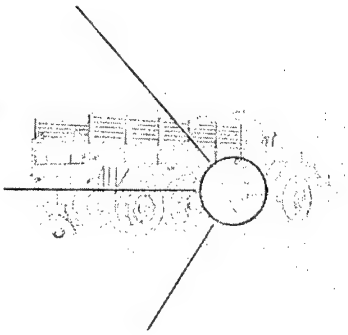
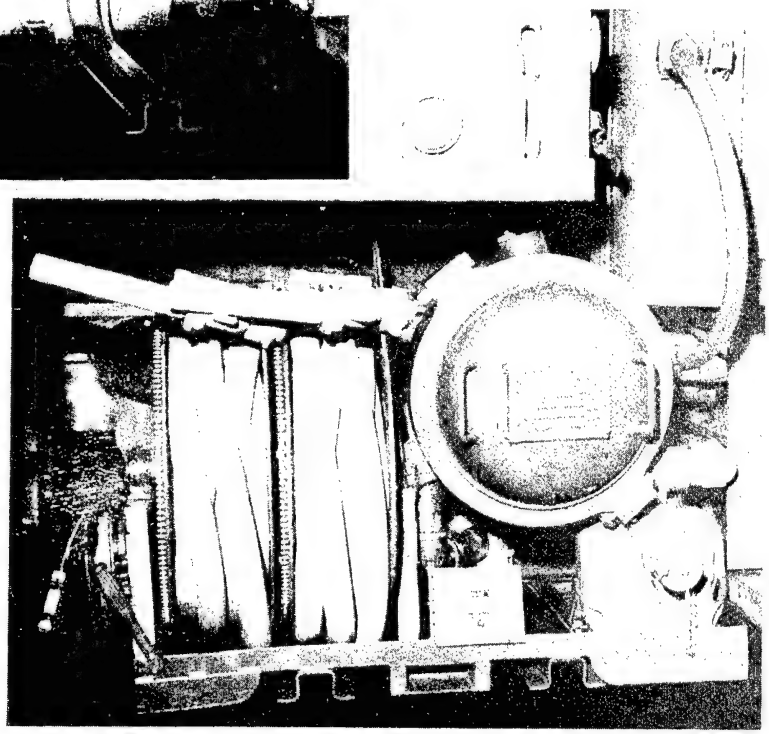




3

TANK AND PUMP UNIT, LIQUID DISPENSING, TRUCK MOUNTED

Figure - 15

e. Conversion Outfit, Army and USAF Cargo Aircraft. This system will provide a means for rapidly loading aircraft with bulk fuel containers, transporting the fuel by air to a forward airfield and rapidly unloading the containers. Approval was received this year from USAF to transport 500-gallon collapsible unvented containers in USAF aircraft with no further testing. Therefore, type classification of the 500-gallon container (scheduled this year) will include this application. This will be the interim system pending design of a system utilizing the military bulk fuel container. Ultimately the system will consist of a quantity of military bulk fuel containers (held in place with standard USAF tie-downs) and a flexible manifolding arrangement with necessary fittings and components such as fueling devices to permit quick, safe and complete fueling/defueling.

f. & g. Conversion Outfit for Railway and Marine Equipment (5000-Gallon Collapsible Container). These outfits consist of the application of 5000-gallon containers (formerly 6000) to foreign and domestic, standard or available railroad and marine (see Figure 16) cargo equipment to supplement special purpose tankers. The containers have a pillow-shaped configuration, are approximately 38-feet long by 7½-feet wide, weigh about 800 pounds (empty) and are fabricated of three-ply high-strength fabric coated with compounded synthetic rubber. When not in use, the collapsed container can be compacted by folding to about 4% of its filled volume for shipment and storage. Transportability tests of the container in marine craft and on railroad cars were completed this year by Transportation Corps. Service tests with fuel (instead of water) are scheduled for completion this year (see also 1c).

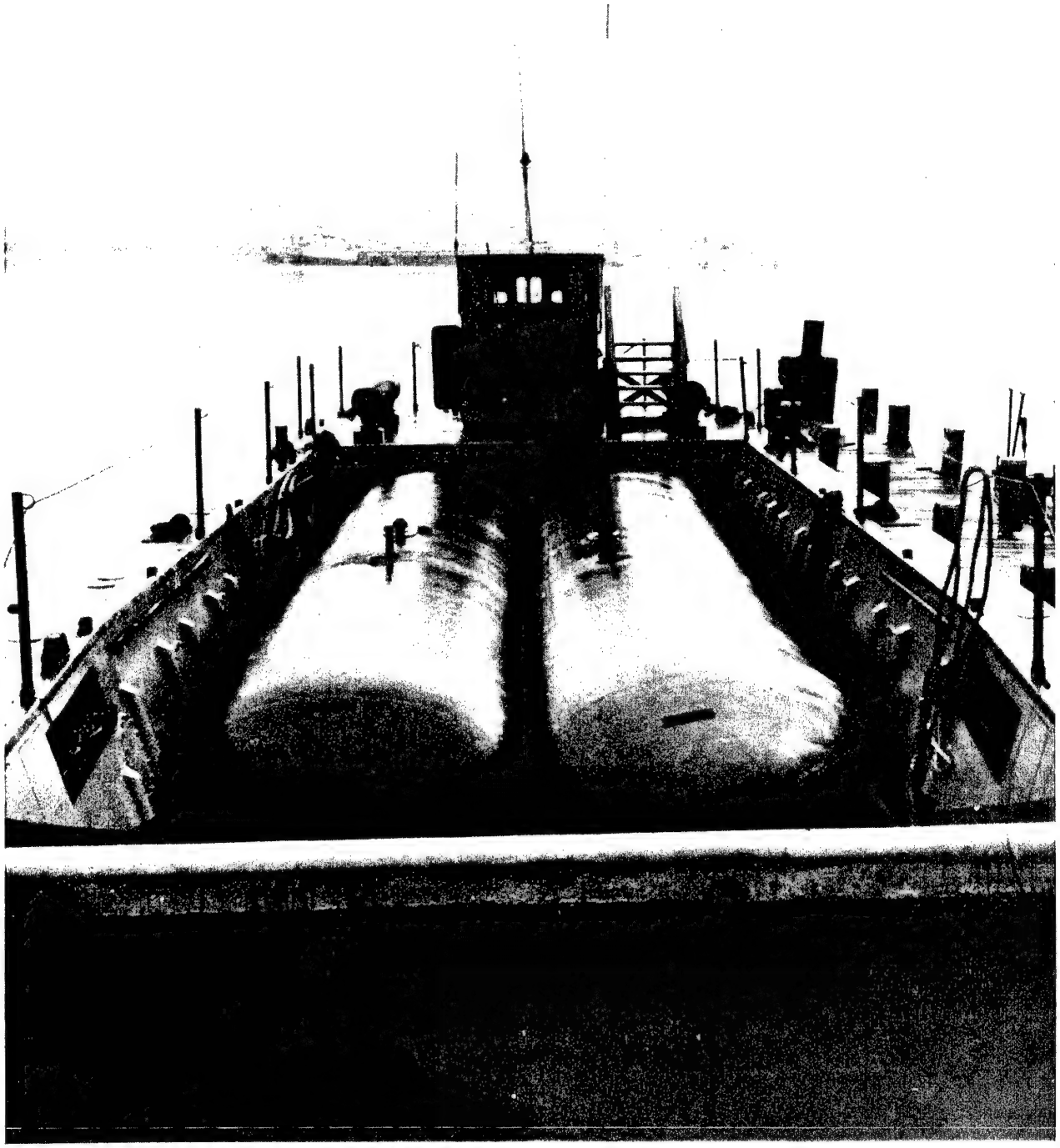


Figure 16. The 5,000-gallon collapsible container, shown here in marine craft, will permit the use of general-purpose rail and marine equipment for transporting POL.

h. Conversion Outfit, Cargo Missile. Funds were not programmed this year for work on this project.

i. Conversion Outfit, Pressure Dispensing, Expendable Components or Pressure Dispensing Kit for Isolated Unit Resupply. Engineering tests of this pressure dispensing kit were programmed early this year; however, such testing has been indefinitely delayed owing to D/A rejection in the FY 62 budget review with consequent removal of official sanction for currently programmed development efforts. A QMR is being prepared for a lightweight combat expendable dispensing system and the item will be reinstated if this requirement is established. Equipment currently available is noisy in operation and is too bulky, heavy and vulnerable for drop into forward combat areas.

j. Elastomeric and Plastic Compositions. Work continued this year on the investigating of elastomeric materials for use in fabricating equipment to handle POL products and developing better elastomeric compounds. Work has been concentrated on isocyanate type elastomers. Solid materials were developed that had the same properties, after compounding, as the liquid materials. Small prototype cylindrical containers and gaskets for quick-connecting couplings were made using this material and tested in the laboratory. Improvements in the low temperature properties of this material over commercial materials were so marginal that further work toward making an item from this material was discontinued. Work is continuing to investigate blends and mixtures to exploit all advantages of the polyurethanes.

Basic research on improving the processing characteristics of fluorocarbon elastomers continued. It was found that diethylene glycol monobutylether softens the fluorocarbon so that it processes in a manner similar to that of natural rubber. However, the tensile strength of the resultant vulcanizates was too low to be of use in fabricating end items. Work will continue to develop better compounds from fluorocarbon rubbers.

A new rubber, a copolymer or ethylene/propylene, was evaluated for possible use in POL equipment. Although both polyethylene and polypropylene have good gasoline resistance at room temperature, the copolymer had no gasoline resistance. No further work will be done with this material to develop compounds for use in POL items.

Several rubber compounds were evaluated for quick-connecting coupling gaskets. Rubbers used were polyurethanes, both liquid and solid, Buna N and LS-53. A newly designed gasket

was also evaluated. The LS-53 gasket allowed the quick-connecting coupling to be closed at -40 F and in some cases down to -65 F.

Laboratory low temperature evaluations were made of 500-gallon containers. None of the containers evaluated could be considered to be serviceable at -40 F or below.

Investigations are continuing to develop specific requirements, which will be incorporated into specifications for the coated fabrics used in pillow-type collapsible containers, to improve the durability, low temperature flexibility and chemical resistance of these containers.

3. CLASS III SUPPLY POINT ASSEMBLAGE

a. Supply Point Assemblage, Bulk Petroleum Products Portable. Task completed.

b. Pump and Filter/Separator, Trailer-Mounted. The unit consists of a filter/separator and gasoline engine driven centrifugal fuel pump with necessary manifold and fittings, each mounted on skids. The unit is designed for transport and operation on a standard $1\frac{1}{2}$-ton Ordnance Corps trailer, or for independent operation of each component on the ground at the user's discretion. Design of this item is expected to be completed next year. The item is scheduled for thorough evaluation by the Quartermaster Corps for possible integration into the Class III Supply Point System.

c. Tube-In-Strip. This item was disapproved by the Army Staff at QMCTC Meeting Number 1-59, held 14 January 1959. The item was deleted from the program per CRD/DA direction, 2 June 1960.

4. BASE AND MOBILE PETROLEUM LABORATORY EQUIPMENT. There is a continuing requirement for improving quality control techniques and equipment for rapid and accurate evaluation of fuels and lubricants for world-wide use in current and future military engines. Present petroleum laboratories consist of a number of sections which can be erected in a period of eight hours. Emphasis has been placed on improving all components utilized in these laboratory assemblies in order to provide more rapid, effective and accurate methods for analyzing, measuring, gauging and sampling all types of petroleum products (friendly and enemy) and to assure that fuels and lubricants used by the military are free from contamination.

Significant accomplishments include:

a. Low Temperature Combination Unit. Development of a low temperature combination laboratory unit which will meet Air Force requirements for low temperature grease analysis was completed this year for field use as a component of the Petroleum Laboratories. The unit (see Figure 17) inclosed in a stainless steel cabinet, consists of a Low Temperature Kinematic Viscosimeter, capable of maintaining a temperature of -100 F with a sensitivity of 0.025 F; Cloud and Pour-Point Apparatus equipped with two jackets for 30 F, 0 F, -30 F, -60 F and -90 F; and Channel-Point Apparatus capable of maintaining temperatures of -50 F, -30 F and 0 F. Service tests are presently being conducted; type classification is scheduled in 1961.

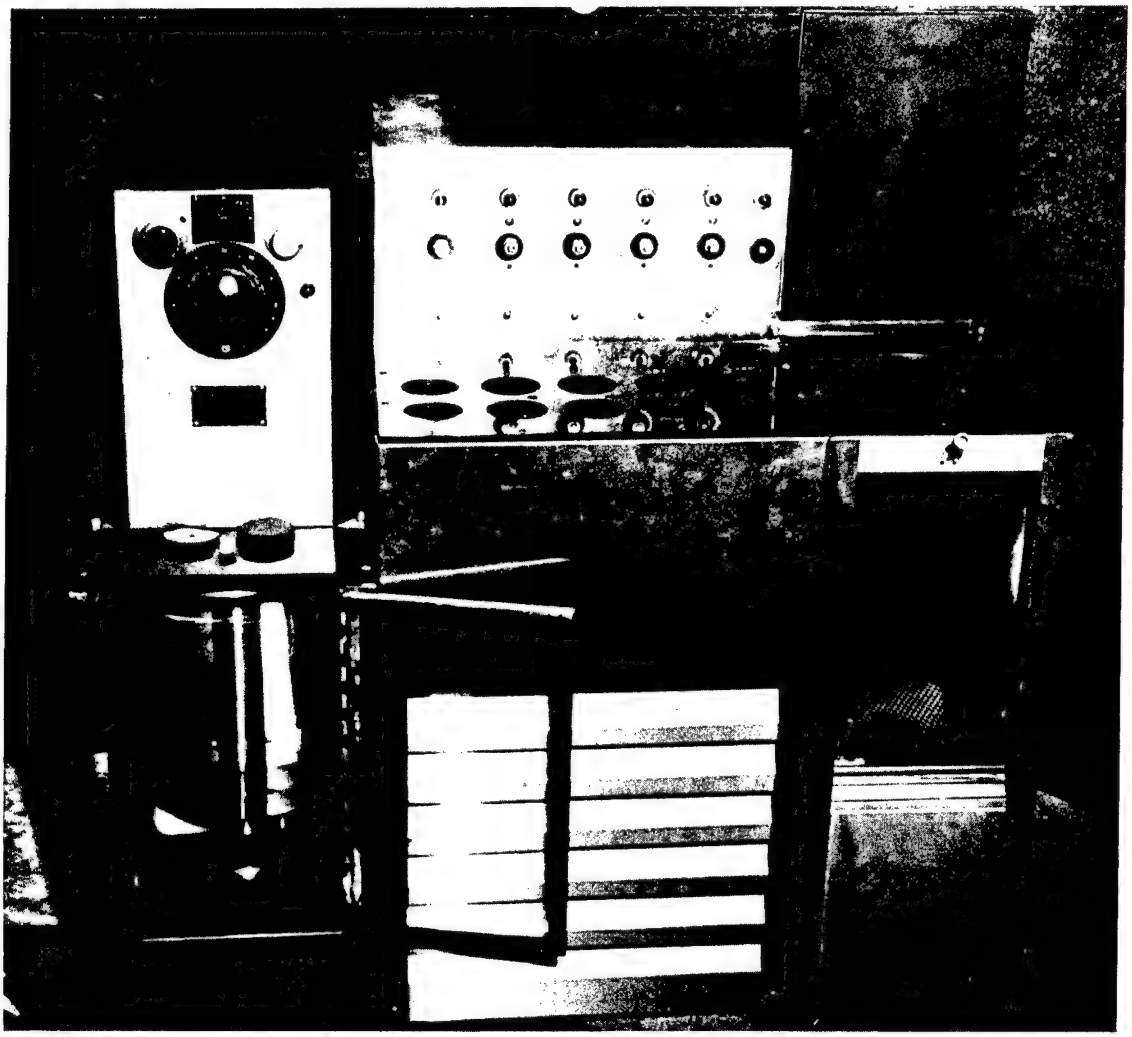


Figure 17. This item which will be used to conduct low temperature analysis of oils and lubricants, will reduce the overall weight of the standard item by 3000-lbs, will accomodate the greater work load required of the Base Laboratories and will withstand the rugged handling and shipping in field use.

b. Fuel Blending Kit. A new metal fuel blending kit has been developed to fulfill a requirement for a fireproof fuel blending kit for petroleum laboratories (see Figure 18). This kit blends various types of referenced fuels for testing octane ratings on automotive combat aviation gasolines. Currently, petroleum laboratories use make-shift units constructed of plywood material which eventually becomes saturated with flammable liquids and creates a serious fire hazard. Tests have been satisfactorily completed; type classification papers are presently being coordinated.

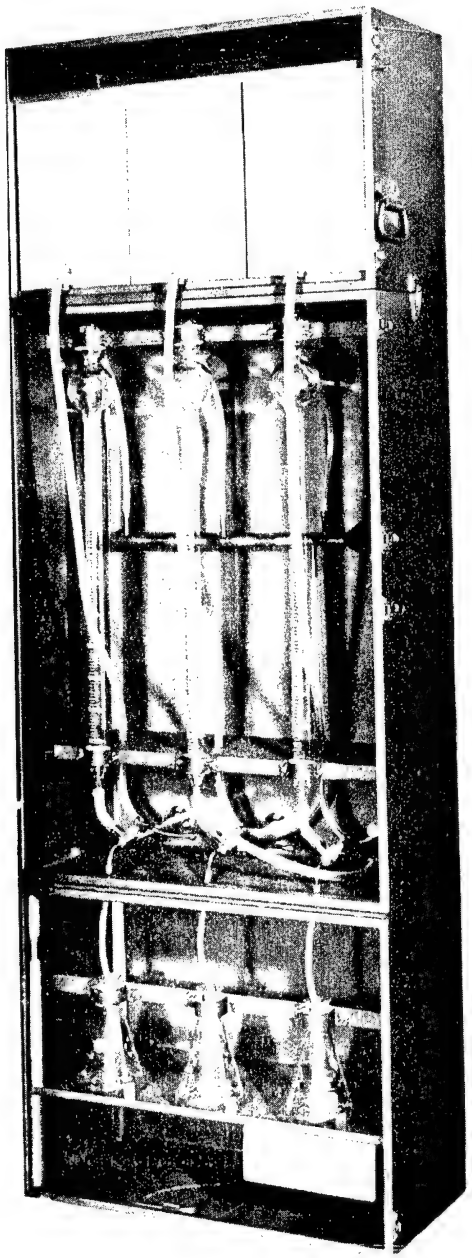


Figure 18. The fuel blending kit simplified testing procedures and minimized fire hazards in the QM Petroleum Laboratories.

c. POL Gauging Kit. A measuring and gauging kit has been developed which provides equipment for measuring and gauging petroleum products in field storage tanks, tank cars and other bulk fuel facilities (see Figure 19). Formerly, this equipment (which consists of standard components) was carried piecemeal; the new kit provides an easier method of handling and carrying the equipment which reduces breakage. Type classification papers are being coordinated.

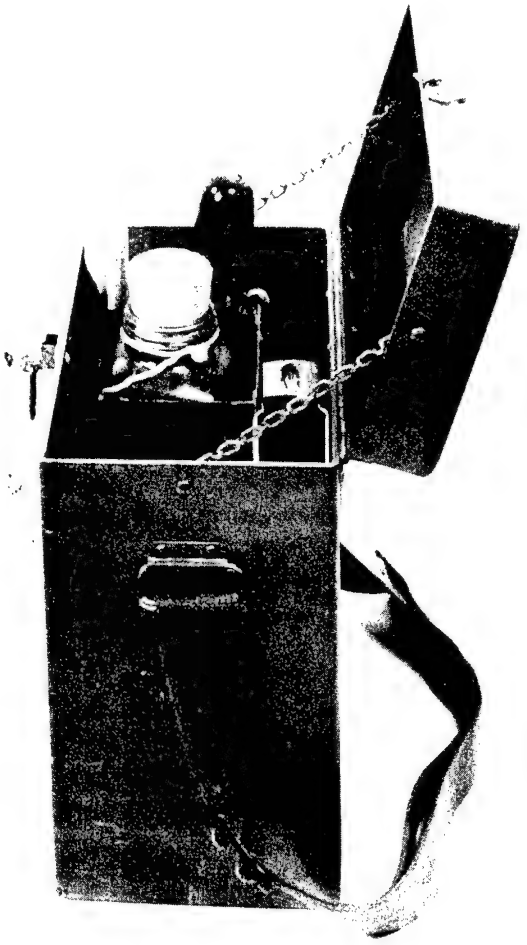


Figure 19. The quality control program of the Army in the field cannot be fully implemented without this measuring and gauging kit, since measuring and sampling now require the handling of excessive equipment and are too time consuming.

d. Lightweight COT (Coordinated Oil Testing) Knock-Testing Engine. In view of requirements for simplified lightweight, multipurpose items, efforts have been directed toward developing a single lightweight knock-testing engine, capable of performing the five standard test methods for rating fuels, which currently must be performed by different types of testing equipment; namely, Motor Method, Research Method, Aviation Method, Supercharge Method, and Cetane Method. (see Figure 20).

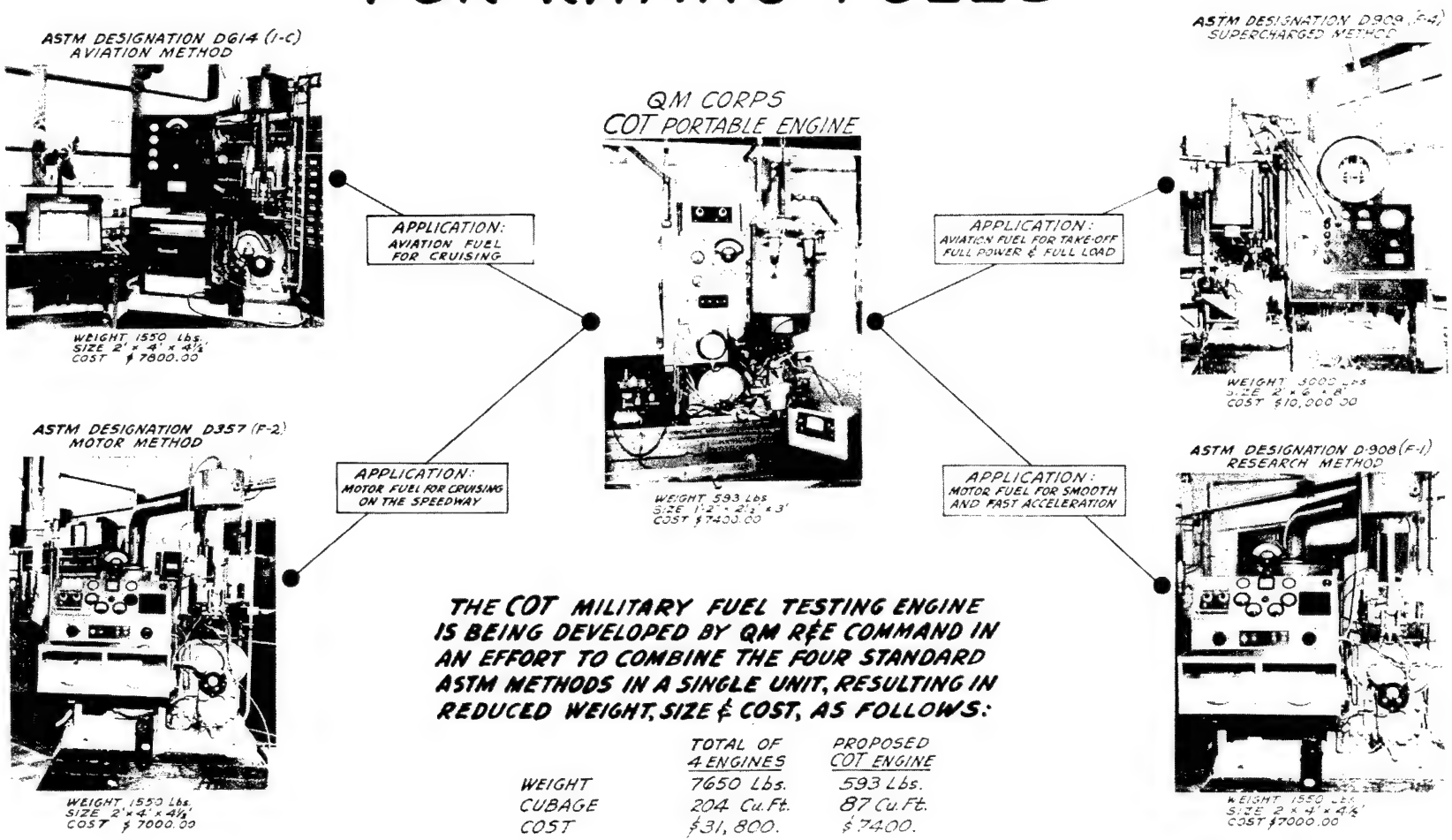


Figure 20. The lightweight COT knock-testing engine will be lighter and lower in cost than the standard engine.

Satisfactory service tests of Motor and Research Methods were completed in 1960 by the Petroleum Division, Schenectady General Depot, QM Petroleum School and Ordnance Automotive Engineering Laboratory. Type classification action has been initiated for this unit for testing Motor and Research Methods. Modification kits are necessary for testing by Supercharge, Aviation and Cetane Methods. Additional efforts are being directed toward completing development of these conversion components.

e. Quality Assurance Device for Army Aircraft Refueling. A program has been initiated to develop a simple, lightweight product-quality indicator to permit the safe and reliable use of standard dispensing equipment in forward airfield refueling of Army aircraft. The QMR is being processed. Initial investigations include the evaluation of related programs being conducted by USAF and Navy.

5. STUDY OF DISPENSING EQUIPMENT AND TECHNIQUES IN POLAR REGIONS. This project was not funded this year.

6. ADVANCED POL SYSTEMS. In an attempt to provide for timely distribution of appropriate POL from the Class III Supply Points to the combat user under modern mobility concepts, studies are being undertaken at QMREC. These studies are aimed at evaluating current equipment in conjunction with new concepts, defining the problem areas and identifying promising and productive developmental areas to solve the extremely difficult problems associated with bulk POL supply to highly mobile units.

7. QM BOARD STUDY. In May 1960, The Quartermaster Board issued a report on Petroleum Supply for the Army in the Field (classified SECRET) in which the Board reviewed POL distribution problems in a field army. Emphasis was placed on the serious need for visionary development programs in order to meet projected requirements in highly mobile operations.

PART 3

TRANSPORTATION CORPS

The U. S. Army Transportation Corps, through its Research and Engineering Command, Fort Eustis, Virginia, conducts research and development directed toward improved transportation of POL Products and has placed emphasis on implementing the Department of the Army POL 5-Year Program. Significant accomplishments during the past year include:

1. TRANSPORTER, LIQUID, ROLLING WHEEL-TYPE

There are three different transporters, liquid, rolling wheel-type, in various stages of development. These are the 1000-gallon T-3, 600-gallon T-4 and 1000-gallon T-6. There are also programs underway to develop a fuel cell wheel (tire) from polyurethane compounds and to develop a Rolling Liquid Transporter Trailer that utilizes the T-3 transporter for running gear.

a. 1000-Gallon T-3 Transporter. The 1000-gallon T-3 transporter was placed in limited production during the past year and was distributed to the 7th U. S. Army, CONARC, USARAL, TREOG, United Kingdom, Canada and others for user evaluation. The 1000-gallon T-3 transporter is built around two (2) balloon tire type containers that can be operated with as little as four (4) pounds per square inch internal pressure (see Figure 21). The two (2) containers are mounted on opposite ends of a common axle that is in turn attached through its center to a draw-bar. The transporter is 138 inches long (reducible to 64 inches by removing the tow-bar), 98 inches wide, 64 inches high and weighs 2240 pounds empty.

Air-over-hydraulic brakes, tool and hose box, tail light, hand operated fuel-air pump (15 psi), fuel hose and nozzle, fuel container repair kit, and manuals are contained on each transporter. A fuel filter/separator is available as an accessory. The T-3 transporter has been successfully transported by air, dropped by parachute, and floated. Towing speeds range from 10 MPH to approximately 30 MPH, depending upon type of terrain being traversed and the number of transporters being towed.

Figure 21. 1000-gallon T-3 Rolling Liquid Transporter

b. 600-Gallon T-4 Transporter. The 600-gallon T-4 transporter resembles the 1000-gallon T-3 in general appearance; however, it has special features which make it more versatile (see Figure 22). The two (2) 300-gallon fuel cell wheels used are filled or emptied from a common point on the frame thus providing the capability for discharging fuel while in motion. The fuel cell wheels are no wider than the track on most tracked prime movers and the tread gauge can be adjusted to 58 inches, 68 inches or 103 inches, so the transporter will follow in the tracks of many prime movers when operating through deep snow or mud. The configuration of this transporter allows it to be towed safely at speeds up to 40 MPH. A filter/separator is provided. Five (5) T-4 transporters have been constructed and are currently being subjected to engineering tests at Fort Eustis, Virginia and Yuma Test Station, Arizona.

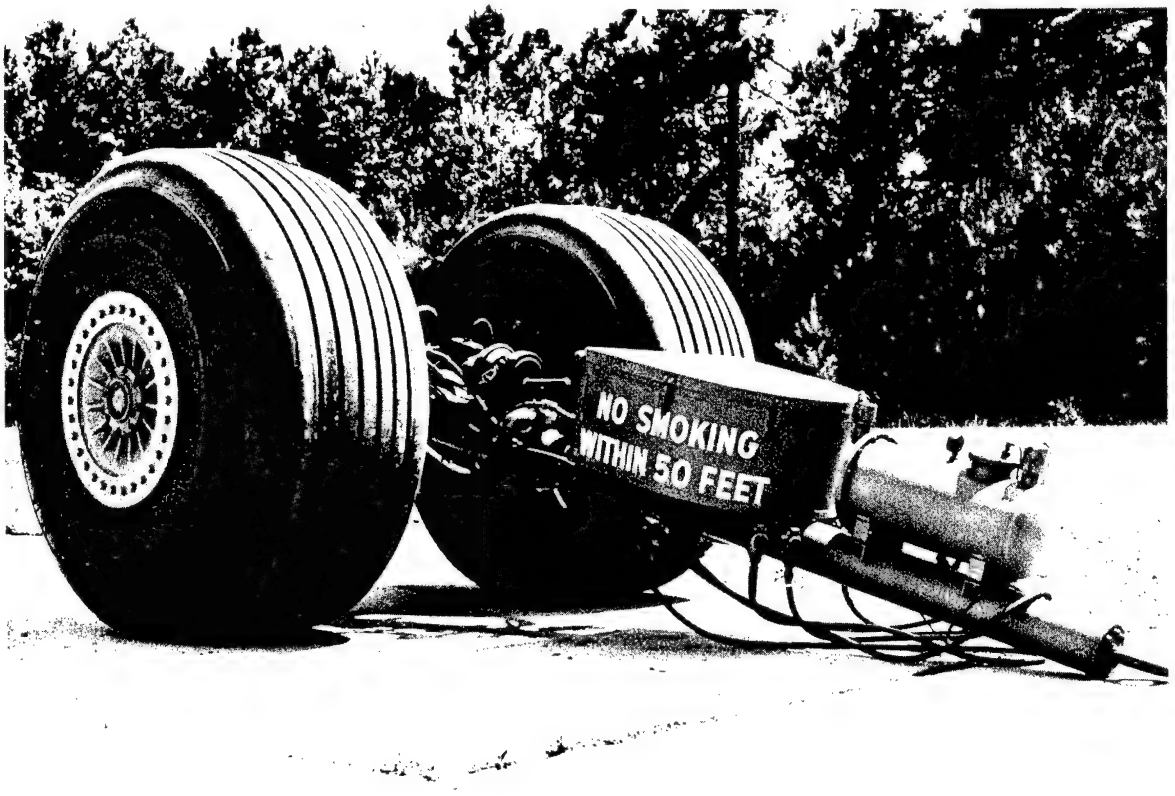


Figure 22. 600-gallon T-4 Rolling Liquid Transporter

c. 1000-Gallon T-6 Transporter. The 1000-gallon T-6 transporter is an advanced Military version of the 1000-gallon transporter. This transporter has two (2) fuel cell wheels having a capacity of 500-gallons (each) like the T-3 but differs from the T-3 in many other ways. The T-6 has a lock-up feature to provide co-rotation of the two (2) fuel cell wheels at highway speeds and differential action at low speeds. This feature when combined with the improved lunette and fuel cell wheel design should result in a transporter that can be towed at 40 to 45 MPH. The T-6 also has simpler emptying and filling components that can be more compactly

stored than those provided with the T-3. A filter/separator is provided. Five (5) T-6 transporters are scheduled for delivery in February 1961. These are to undergo an expedited engineering test and minor redesign where necessary. When this is completed, fifteen (15) additional units are to be constructed for user evaluation starting in October 1961.

d. Polyurethane Fuel Cell Wheel. A program is underway to develop a 500-gallon fuel cell wheel from polyurethane compounds. This wheel, which is being designed to fit the 1000-gallon T-3 and the 1000-gallon T-6 transporters, should have at least twice the tread life of the current synthetic rubber wheel and will have a greater operating temperature range. The possibility of fuel contamination from the compounds used will be greatly reduced because polyurethane is relatively inert to any liquid the transporter will carry. Several wheels are scheduled to start engineering testing at Fort Eustis, Virginia in July 1961.

e. Rolling Liquid Transporter Trailer. A simple kit (see Figures 23 and 24) has been developed to convert two (2) 1000-gallon T-3 transporters into a trailer capable of transporting 2000-gallons of liquid in its wheels and 6000-pounds of dry cargo on its bed. Three (3) of these trailers were constructed and tested at Fort Eustis, Yuma Test Station, and on the Greenland Icecap during 1960. An improved trailer kit having simpler construction and lighter weight has recently been completed and will undergo engineering testing at Fort Eustis.

2. RAIL TANK CAR, UNIVERSAL GAUGE

All drawings have been completed. AAR testing of the side frames and bolsters is complete and the AAR has given TC approval to operate this tank car, with the multi-gauge feature, in domestic interchange service. This Universal POL Transporter, which will replace the standard domestic and foreign railway tank cars which currently must be stock-piled against mobilization requirements, can be loaded with POL products in CONUS and, in roll-on and roll-off operations expedite delivery overseas, thus effectively supporting the concept of bulk delivery as far forward as possible before breakdown into smaller containers.

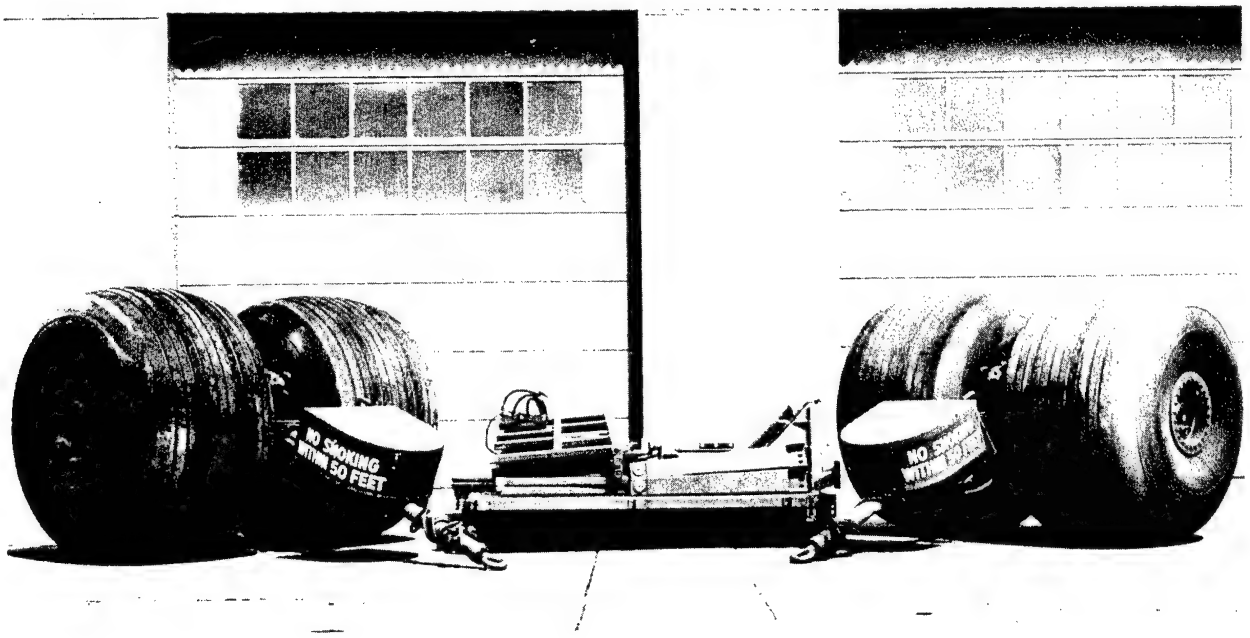


Figure 23. Rolling Liquid Transportation Trailer Kit and Two (2) (ea) 1000-gallon T-3 Rolling Liquid Transporters.

Figure 24. Rolling Liquid Transporter Trailer (Assembled)

PART 4

ORDNANCE CORPS

The Petroleum Handling Equipment Program for the Ordnance Corps is concentrated at U. S. Army Ordnance Tank-Automotive Command, Detroit, Michigan. Major efforts are continuing toward developing lighter and more mobile semi-trailers, trucks, and GOERs for handling motor and aviation fuels. The latest designs for the fuel servicing and bulk vehicles incorporate automatic bottom loading, fast fueling capabilities, and improved safety features. When specified, they may be equipped with over and under type fueling for aircraft on off-base locations. As a means of further improving the petroleum supply and distribution capability of the future field Army, Ordnance Corps POL specialists and engineers are placing emphasis on (1) equipping currently available tank trucks with effective filter/separators developed by Corps of Engineers wherever required, (2) increasing fuel acceptance rate of all combat vehicles, (3) improving on-vehicle equipment for refueling Army aircraft and ground vehicles, (4) improving tank bodies by utilizing non-corrosive materials, (5) developing low center of gravity, lightweight tank bodies for new vehicles, (6) increasing refueling rates by closed pressure systems to 110 gallons per minute or better on fuel servicing vehicles, and (7) studying bullet-sealing features. Accomplishments which provide significant tactical and logistical support to future field commanders include:

1. TANK BODY TRANSPORT VEHICLES

a. Truck, Tank, Fuel Servicing, 1,250-Gallon, 2½-Ton, 6x6, XM385. These are test bed vehicles incorporating bulk hauling and a refueler version with various special features incorporated for test. One of the versions is planned to replace the current standard Truck, Tank, Gasoline, 1,200-Gallon, 2½-Ton, 6x6, M49, M49C, and M217. It includes a fiberglass-reinforced plastic tank, low center of gravity, and rectangular configuration. The plastic, in addition to being a non-critical material, is expected to eliminate maintenance and contamination problems resulting from corrosion of steel tanks, which has been difficult to control due to dissolving and chipping of tank lining materials. Another version of this vehicle will incorporate a self-sealing tank lining to provide protection against small arms fire up to .50 caliber, 20 mm shell, or HE fragments. Both versions of the XM385 will incorporate a 250 to 300 gpm horizontal filter/separator (same as the M131E6 semi-trailer to provide interchangeability of components), automatic bottom loading, controlled over-wing aircraft refueling provisions, standby jet aircraft one point type refueling equipment, and possibly, a closed pressure delivery system for test and evaluation. It will have three hose reels mounted on the vehicle, and each will contain a 50-foot length of 1¼-inch hose for vehicle refueling. An additional reel with

50-feet of 2½-inch hose for aircraft refueling will also be provided. Defueling provisions (evacuation system) and other improved features not included in current standard fuel tank vehicles will also appear on this vehicle. XM385 and XM385E1 prototypes are scheduled for delivery in June 1961 being delayed from the original date in order to incorporate the new Corps of Engineers filter/separator.

b. Truck, Tank, Fuel Servicing, 1,500 Gallon, 5-Ton, XM468. This vehicle was intended primarily for use by Armored Division. The initial requirement was for a tanker utilizing the 5-ton, 6x6 chassis with conventional tank and refueling equipment which could be produced with minimum lead time. Subsequently, it was determined that the ultimate chassis should be a unit of the Ordnance medium series, advanced design trucks, which will replace the present 5-ton, 6x6 truck. Development of this vehicle has been postponed, and FY 1960 funds for this purpose were programmed to other tasks. Pending the outcome of the medium series truck development program, it is anticipated that a vehicle in this category for the chassis selected will be developed. It does not appear at this time that tank body versions will be available for production prior to 1965 and initiation of development has not as yet been finalized. The Ordnance Corps separate tank body development program permitting the needed advanced development of tank bodies is being terminated (tank bodies in the future may possibly be developed under vehicle projects). Accordingly, advanced development of these tank bodies can not now be scheduled

c. Truck, Tank, Fuel Servicing, High Mobility, 5,000-Gallon, 4x4, XM438 (GOER) (See Figure 25). This vehicle of unique design is intended to provide a larger capacity tanker with optimum mobility over rough terrain and inland waterways which are impassable to conventional trucks and trailers. It is equipped with large diameter, low pressure tires which provide high ground clearance and serve as a suspension system to absorb road shock. The body, power train, steering, braking and over-all configuration incorporate features not used in other military vehicles, and provide exceptional performance characteristics. The XM438 tank and fuel handling equipment are of commercial design and are intended to serve only for evaluation of the principles involved. As of June 1960, three XM438 prototypes have completed tests at the Armor Board, Arctic Test Board, Yuma Test Activity and also evaluation by the Quartermaster. Test results were satisfactory with the recommendation that expedited development of the XM438E1 be accomplished. Four XM438E1 prototypes, incorporating fuel tank and ancillary equipment of military design and other improvements, are scheduled for delivery to test agencies early in FY 1961 for expedited engineering and user evaluation. A Corps of Engineers developed filter/separator of 300 gpm for aviation as well as vehicle fuel will be installed on the XM438E1 vehicle. It is intended that in order to save space on the vehicle, this filter/separator will be located within the fuel cargo tank of the vehicle accessible from the top for service.

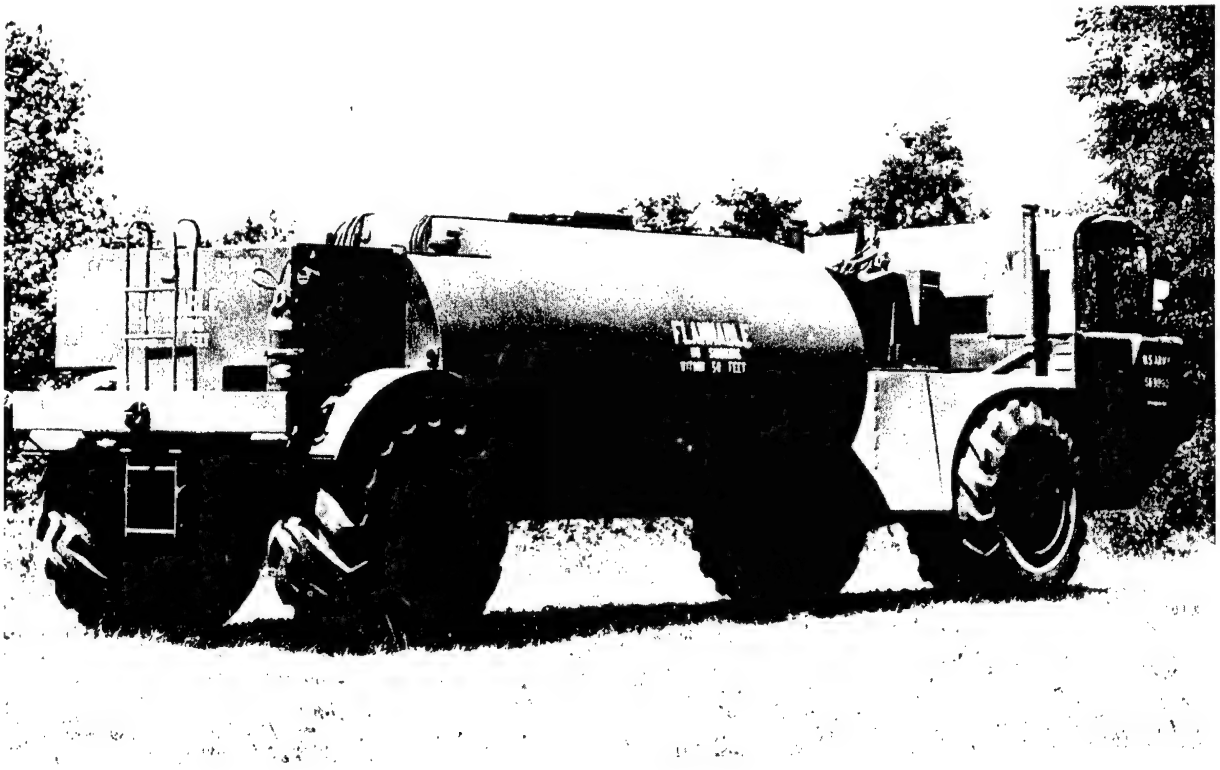


Figure 25. Truck, Tank, Fuel Servicing, High Mobility, 5,000 Gallon, 4x4, XM438 (GOER) - will provide a larger capacity tanker with optimum mobility over rough terrain and inland waterways which are impassable to conventional trucks and trailers.

d. Semi Trailer, Tank, Fuel Servicing, 5,000-Gallon, M131E3 (See Figure 26). This vehicle was developed by the Ordnance Corps as an all aluminum version of the M131 series to supersede the original M131, which was excessively heavy (14,850 pounds, curb weight). Major improvements compared to the current standard M131A2 include significantly lighter weight, all aluminum integral frame tank body, shorter over-all length, and filter/separator system. Type classification was scheduled for 4th Qtr FY 1960. This was delayed due to suspension deficiencies and to development of other improved equipment for aircraft refueling. Two other refueler versions of the M131E3 incorporate a closed pressurized system for fast refueling and automatic bottom loading (M131E5) and a filter/separator, meter and other delivery equipment and three 15-foot lengths of suction hose (M131E6). The M131E3 will eventually be replaced by the

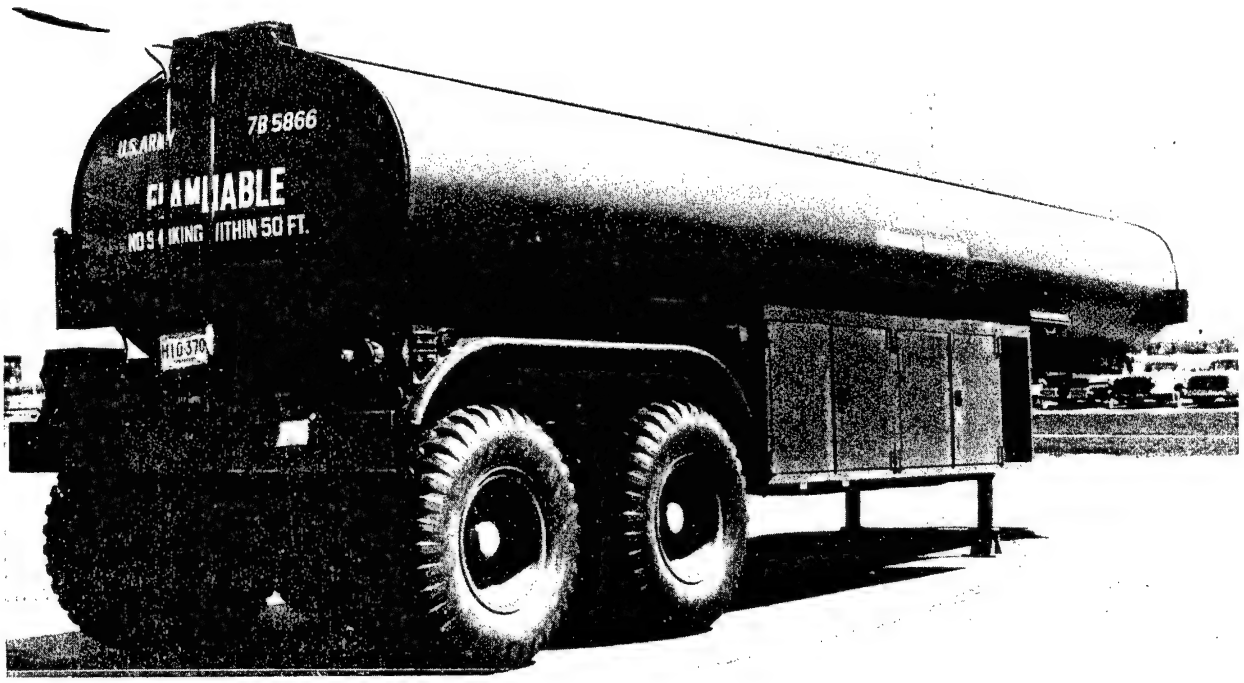


Figure 26. This improved Semi-trailer, Tank, Fuel Servicine, Model M131E3, with Filter-Separator, weighs only 9980 pounds, whereas present standard Model M131A2 weighs 12,400 pounds with no filter system.

M131E6. Semi-Trailer, Tank, Gasoline, 5,000-Gallon, M131E2 is the bulk fuel transporter version of the M131 series and does not incorporate a filter/separator or other aircraft refueling equipment. The M131E2 will be replaced by the M131E4 (see Figure 27) which is the M131E2 modified to provide automatic bottom loading, improved suspension, and correction of deficiencies revealed by engineering tests. Two prototypes of the M131E4 have been completed and are being tested at Aberdeen Proving Grounds, Md.

Figure 27. This is the M131E4 semi-trailer which is the bulk fuel transporter version of the M131 series.

2. AUXILIARY SYSTEM

a. Automatic Bottom Loading. During Operations SLEDGEHAMMER and STRONGARM, it was noted that present methods of loading Ordnance tank vehicles were unsatisfactory. It was evident that a faster, simpler, and less hazardous method, requiring less equipment and manpower, was needed. Hence, the automatic bottom loading system was developed by Ordnance to meet this requirement. By automatic bottom loading the fuel is carried either in pressurized hose lines, elevated gravity feed lines from a stationary non-pressurized tank or pumped into the semi-trailer (which has been coupled to the one tank opening connection on tank vehicle) passing through a filter/separator through pump emergency valves up into the tank compartments and is automatically shut off when the tanks are filled to a correct level. This system places the shut off on an automatic basis and thereby compensates for the human error in fuel loading. The XM131E4 vehicle is now undergoing tests for automatic bottom loading at Aberdeen Proving Ground.

b. Closed Pressure System. Closed pressure system for fast refueling is intended to expedite refueling of military vehicles especially under conditions when accumulated time lost by numerous vehicles awaiting refueling may adversely affect operations. It is being developed by Ordnance with concurrence of the Quartermaster Corps. Five complete kits of this equipment are to be completed in the winter of 1960 - 1961. One kit will be installed in the M131E5 for test purposes. The Automatic Closed Pressure System, as installed on the M131E5 vehicle, consists of an automatic shut-off control for sender unit, filler assembly for receiving unit, fuel cap for receiving vehicle, and hose, hose reel, and pump control for sender unit.

(1) The automatic fuel shut-off control unit will function to fill tank and top it off returning fumes and vapors by venting through a dual hose to the bulk tank of delivery vehicle. This rate of refueling will be up to 50 gpm for fuel tanks under 50-gallons and 110 gpm or up for tanks of larger capacity. A primary and secondary (safety trip) mechanism to insure positive automatic shut off will also be part of this item.

(2) Filter assembly consists of a stand pipe, adapter, and float valve. This will function by producing a pressure signal to close shut off-control when tank capacity has been reached (including topping off operation). It will further reduce foaming to a minimum and will serve as a quick and positive connection of control unit to the fuel tank.

(3) This fuel tank cap has a spring loaded mechanism for quick easy disconnection.

(4) The dual hose, hose reel, and pump control for return of fumes from tank being refueled to delivery unit will also act as a sending unit for fuel. Some further advantages of the closed pressure system are: it will establish a positive automatic system of refueling by a simple means and eliminates the personnel requirement for shut off when tank is filled and topped off; it eliminates escaping fumes, so vehicle engine may be left in operation during refueling operation; and it increases safety in handling JP-4 fuels as well as other types of exotic fuels which require extra safe handling and control of fumes and vapors.

PART 5

SIGNAL CORPS

The Signal Corps, through its Research and Development Laboratory, Fort Monmouth, New Jersey, conducts an extensive research and engineering program on communication equipment. All applicable improvements that have been made in Signal Corps equipment are incorporated and utilized in the movement of POL products. No specialized developments are required at this time for POL operations.

APPENDIX A

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF RESEARCH AND DEVELOPMENT
WASHINGTON 25, D. C.

CRD/D 6088

R&D DIRECTIVE
NR 11

4 March 1960

THE PETROLEUM HANDLING EQUIPMENT RESEARCH AND DEVELOPMENT PROGRAM OF THE DEPARTMENT OF THE ARMY - ANNUAL REPORT (REPORTS CONTROL SYMBOL CSCRD-24)

(Effective until 3 March 1961 unless sooner rescinded or superseded)

1. Reference:

a. AR 701-9100-1, Logistics Responsibilities, Petroleum Supply System.

b. AR 705-5. Research and Development of Materiel.

2. GENERAL: This directive establishes responsibilities and furnishes guidance for the preparation and coordination of the Army's R&D program on POL handling equipment and handling systems and for the preparation of the Department of the Army Annual Report on the Petroleum Handling Equipment R&D Program.

3. PROGRAM COORDINATION:

a. The Quartermaster General, as the head of the Technical Service having dominant interest within the Army for the logistics of petroleum products, is responsible, under guidance provided by the Chief of Research and Development, for the preparation and coordination of the Army's R&D program on petroleum handling equipment and petroleum handling systems. He will assure that the handling systems and components evolved are responsive the the Army's needs for handling petroleum from acceptance of the product by the Army at any point to delivery to the using vehicle or tactical unit.

b. In discharging the above responsibilities, The Quartermaster General will assure that such research and development activities as may be considered essential to advance the Army's capability in this field are initiated and prosecuted by appropriate agencies, even though specific established requirements may be lacking. He will be guided by

the assignments of logistics responsibilities as contained in reference a, cited in paragraph 1 above, in the determination of the appropriate agency to conduct a particular R&D activity. These logistics responsibilities remain unchanged. The Quartermaster General will provide R&D information to the Army Petroleum Panel to enable that panel to monitor and coordinate planning and policy matters in the field of petroleum supply and distribution as required by the cited reference.

c. The Quartermaster General will review and revise the Department of the Army R&D program on petroleum handling equipment on an annual basis in order to carry out the responsibilities described above.

4. REPORTING:

a. Based on his annual review, referred to in paragraph 3c preceding, The Quartermaster General will compile and publish the Department of Army Annual Report on The Petroleum Handling Equipment Research and Development Program. He will utilize Quartermaster Corps data together with material contained in feeder reports supplied by the other Army Technical Services.

b. Each Army Technical Service concerned will contribute to those sections of the annual report dealing specifically with its activities and accomplishments as well as to appropriate sections of a general nature reflecting overall Army accomplishments in this field. This information will be furnished upon request of The Quartermaster General.

c. Information included in this report may be referred to, but need not be included in, the Consolidated R&D Annual Project Report, Reports Control Symbol CSCRD-16.

d. The Annual Report as of 31 December together with The Quartermaster General's recommendations will be dispatched through the Department of Army Petroleum Panel and the Deputy Chief of Staff for Logistics to the Chief of Research and Development by 1 February of each year.

e. Instructions for the preparation of the Annual Report are attached as Inclosure 1.

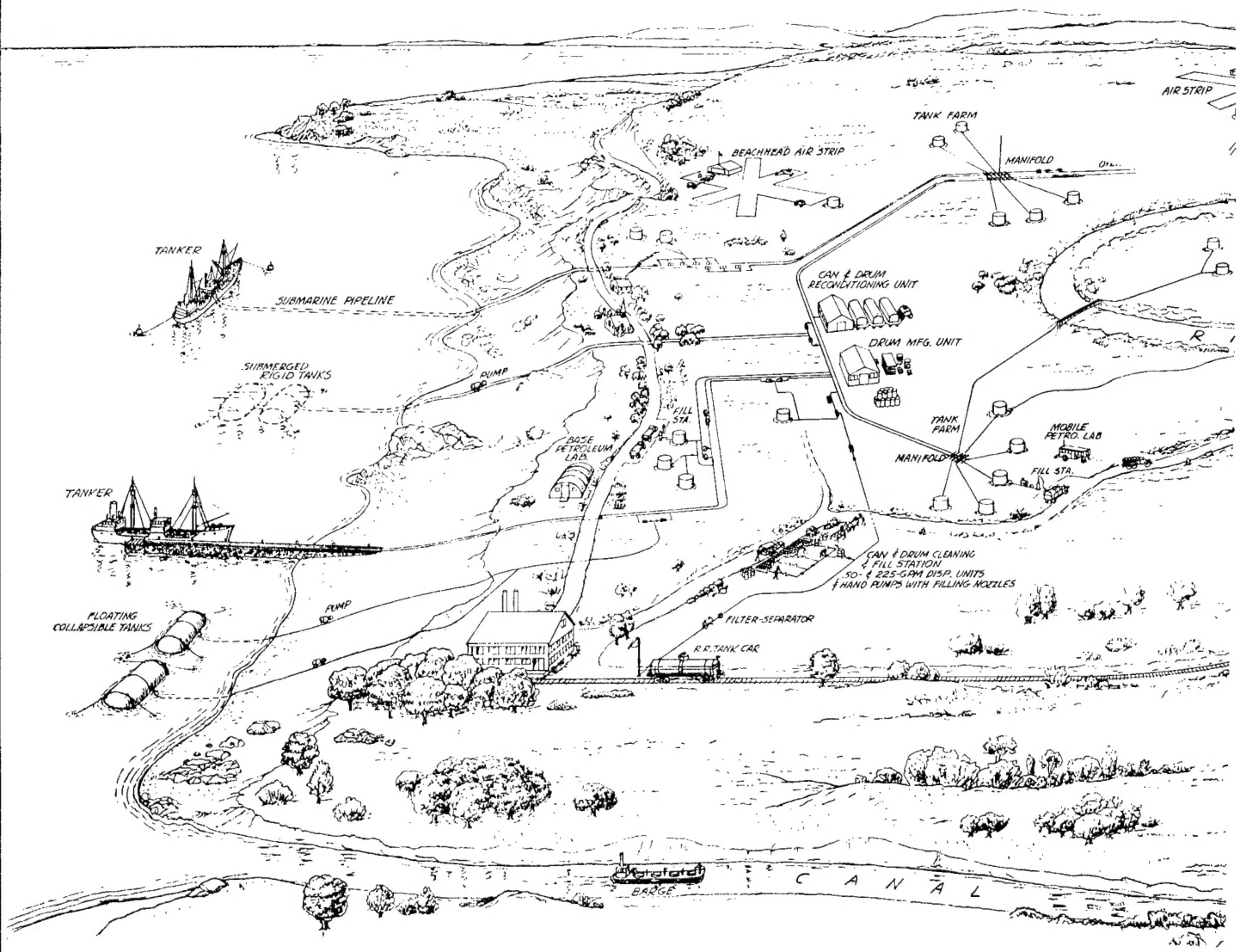
BY DIRECTION OF THE CHIEF OF RESEARCH AND DEVELOPMENT:

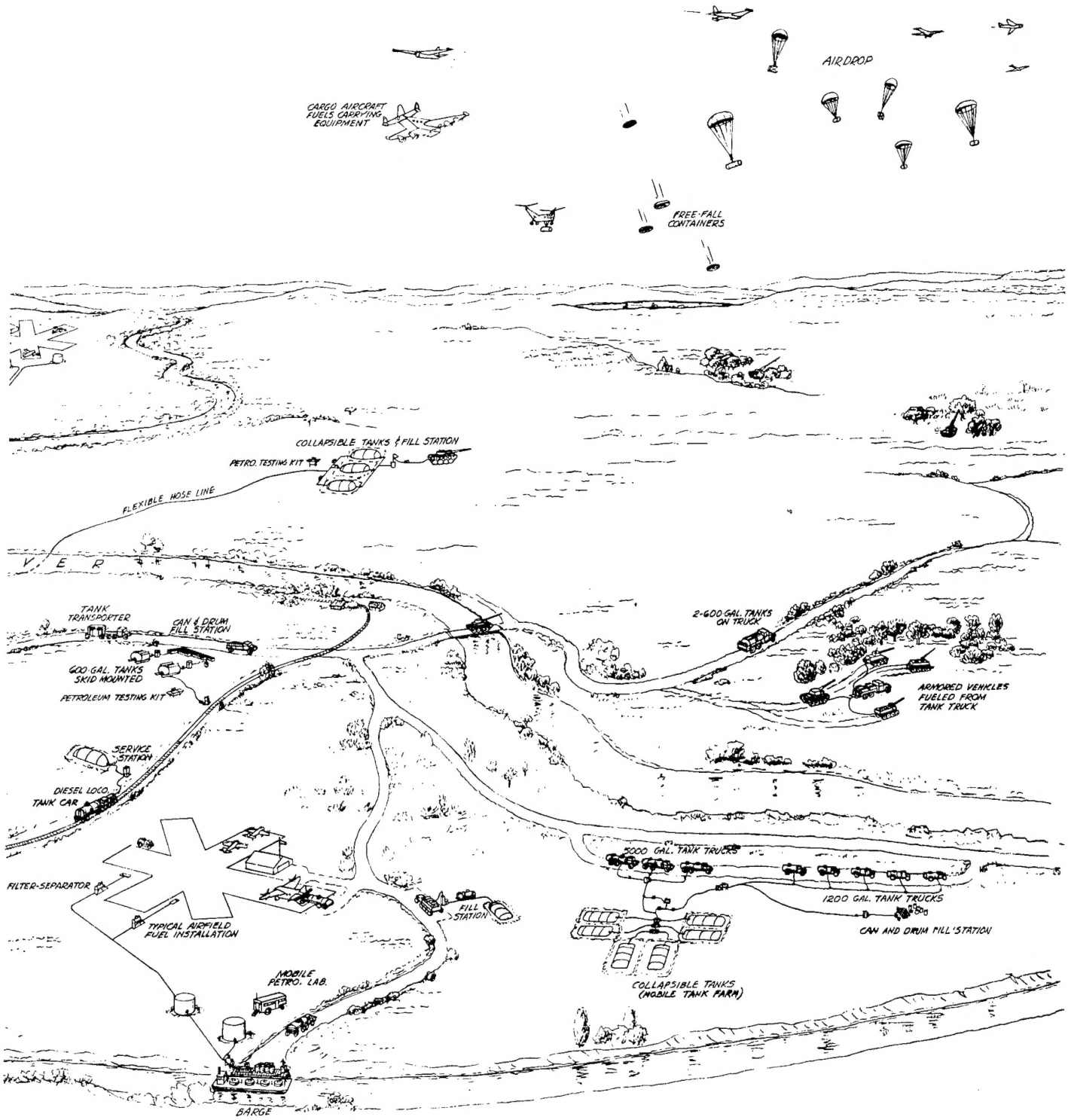
1 Incl
Instructions

ROLAND P. CARLSON
Colonel, GS
Executive

APPENDIX B

ELEMENTS OF A P.O.L. SYSTEM WITHIN A THEATER OF OPERATIONS




AIRDROP
CARGO AIRCRAFT FUELS CARRYING EQUIPMENT
FREE-FALL CONTAINERS
COLLAPSIBLE TANKS & FILL STATION
PETRO. TESTING KIT
FLEXIBLE HOSE LINE
V E R
TANK TRANSPORTER
CAN & DRUM FILL STATION
600 GAL. TANKS SKID MOUNTED
PETROLEUM TESTING KIT
SERVICE STATION
DIESEL LOCO. TANK CAR
2-600 GAL. TANKS ON TRUCK
ARMORED VEHICLES FUELED FROM TANK TRUCK
5000 GAL. TANK TRUCKS
1200 GAL. TANK TRUCKS
CAN AND DRUM FILL STATION
FILTER-SEPARATOR
TYPICAL AIRFIELD FUEL INSTALLATION
FILL STATION
MOBILE PETRO. LAB.
COLLAPSIBLE TANKS (MOBILE TANK FARM)
BARGE

[redacted]

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Chief of Engineers

Chief of Ordnance

Chief Signal Officer

Chief of Transportation

U. S. Marine Corps

Bureau of Supplies & Accounts, U. S. Navy

Commandant, Army War College, Carlisle Barracks, Pa. (Attn: Library)